The world's most comprehensive encyclopedia of the military weapons of the 20th century

12 PASS

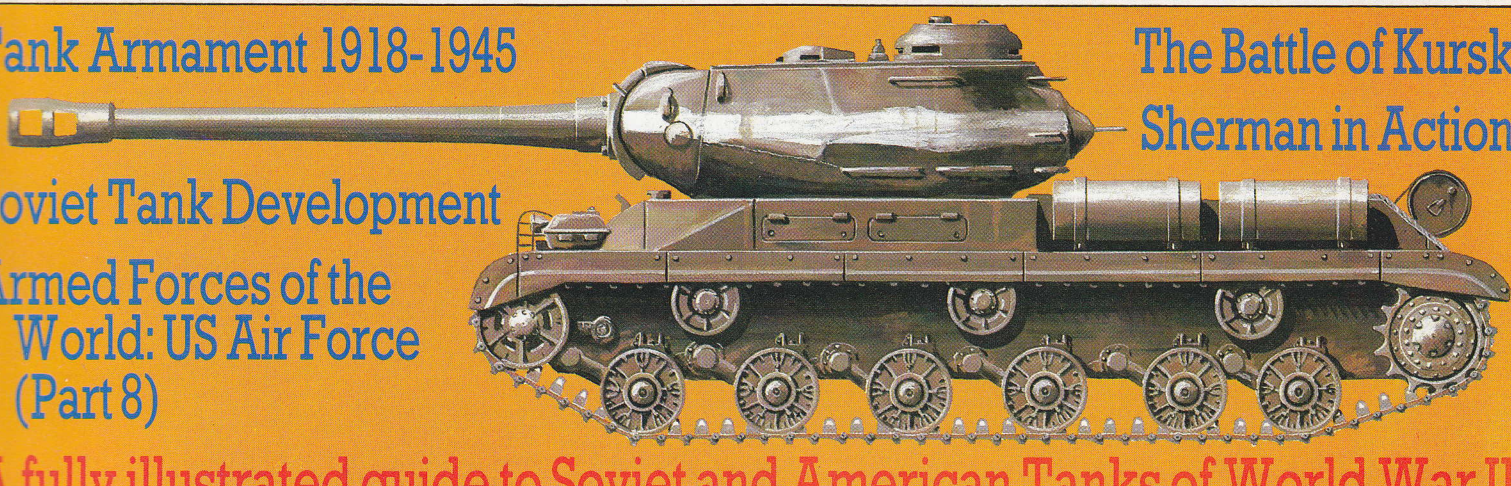
WAR MACHINE

An ORBIS Publication

53

80p

IR £1 Aus $1.95 NZ $2.25 SA R1.95 Sing $4.50 USA & Can $1.95



Tank Armament 1918-1945

Soviet Tank Development

Armed Forces of the World: US Air Force (Part 8)

The Battle of Kursk

Sherman in Action

A fully illustrated guide to Soviet and American Tanks of World War II

WAR MACHINE

Volume 5 **Issue 53**

CONTENTS

Soviet and American Tanks of World War II

Light Tank M3 1042
Light Tank M24 Chaffee 1042
Medium Tank M3 1044
Medium Tank M4 1044
Tank Armament 1918-1945 1045
Heavy Tank M26 Pershing 1046
Sherman in Action 1047
T-40, T-60 and T-70 light tanks 1052
T-26 light infantry tank 1052
T-28 medium tank 1053
BT-7 fast tank 1054
Soviet Tank Development 1055
The Battle of Kursk 1056
T-34 medium tank 1058
T-35 heavy tank 1059
KV-1 heavy tank 1059
IS-2 heavy tank 1060

Armed Forces of the World

US Air Force (Part 8) iii

Published by
Orbis Publishing Ltd
© Aerospace Publishing Ltd 1984

Editorial Offices
War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
London W4 4PH
Managing Editor: Stan Morse
Editorial: Trisha Palmer
Chris Bishop
Jon Lake
Chris Chant

Design: Rod Teasdale
Colour Origination: Imago Publishing Ltd, Thame, Oxon
Typesetting: SX Composing Ltd
Film work: Precise Litho Ltd
Artists:
David Etchell
Ray Hutchins
S. Hohara

6849

Printed in Great Britain by The Artisan Press Ltd

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:
Orbis Publishing Ltd
Orbis House
20-22 Bedfordbury
London WC2N 4BT
Telephone: 01-379 6711
Circulation Director: David Breed
Marketing Director: Michael Joyce

WAR MACHINE
Price UK 80p. IR £1. Aus $1.95. NZ $2.25. SA R1.95. Singapore $4.50. USA and Canada $1.95

How to obtain your copies of WAR MACHINE: Copies are obtainable by placing a regular order at your Newsagent, or by taking out a subscription.

Subscription Rates
For six months (26 issues) £23.80; for one year (52 issues) £47.60. Send your order and remittance to Punch Subscription Services, Watling Street, Bletchley, Milton Keynes, Bucks MK2 2BW, being sure to state the number of the first issue required.

Back Numbers
UK & Eire: Back numbers are obtainable from your Newsagent or from WAR MACHINE Back Numbers, Orbis Publishing Limited, 20-22 Bedfordbury, London WC2N 4BT at cover price.
Australia: Back numbers are obtainable from WAR MACHINE Back Numbers, Gordon & Gotch (Aus) Ltd, 114 William Street, PO Box 767G, Melbourne, Vic 3001.
South Africa, Europe, Malta and New Zealand: Back numbers are available at cover price from your Newsagent. In case of difficulty write to the address in your country given for binders. South African readers should add sales tax.

How to obtain binders for WAR MACHINE
UK & Eire: Send a cheque or Postal Order for £3.95 per binder (incl p & p) payable to Orbis Publishing Ltd to WAR MACHINE Binders, Orbis House, 20-22 Bedfordbury, London WC2N 4BT
Europe: Write with remittance of £5.00 per binder (incl p & p) payable to Orbis Publishing Ltd to WAR MACHINE Binders, Orbis House, 20-22 Bedfordbury, London WC2N 4BT.
Malta: Binders are obtainable through your local Newsagent, price £3.95. In case of difficulty write to WAR MACHINE Binders, Miller (Malta) Ltd, M.A. Vassalli Street, Valletta, Malta.
Australia: For details of how to obtain your binders see inserts in early issues or write to WAR MACHINE Binders, First Post Pty Ltd, 23 Chandos Street, St Leonards, NSW 2065. The binders supplied are those illustrated in the magazine.
New Zealand: Binders are available through your local Newsagent or from WAR MACHINE Binders, Gordon & Gotch (NZ) Ltd, PO Box 1594, Wellington.
South Africa: Binders are available through any branch of Central News Agency. In case of difficulty write to WAR MACHINE Binders, Intermag, PO Box 57394, Springfield 2137.

Note: Binders and Back Numbers are obtainable subject to availability of stocks. Whilst every attempt is made to keep the price of the issues and binders constant, the publishers reserve the right to increase the stated prices at any time when circumstances dictate. Binders depicted in this publication are those produced for the **UK market only** and may not necessarily be identical to binders produced for sale outside the UK. Binders and issues may be subject to import duty and /or local taxes, which are not included in the above prices unless stated.

The WAR MACHINE published by Orbis Publishing Ltd has no connection with the WAR MACHINE published by Emjay. The latter is a magazine devoted to computer simulation gaming and further information and subscription details can be obtained from Emjay, 17 Langbank Avenue, Rise Park, Nottingham NG5 5BU, England.

Picture acknowledgements
1042: Imperial War Museum. **1044:** Imperial War Museum. **1046:** Imperial War Museum. **1047:** Imperial War Museum. **1048:** Imperial War Museum/Imperial War Museum/Imperial War Museum. **1049:** Imperial War Museum/Imperial War Museum/US Marine Corps. **1052:** Imperial War Museum. **1053:** Imperial War Museum/Imperial War Museum. **1054:** Imperial War Museum/Imperial War Museum. **1055:** TASS/Imperial War Museum. **1058:** Imperial War Museum/TASS. **1059:** Imperial War Museum/Imperial War Museum. **1060:** Imperial War Museum/Imperial War Museum/TASS. **(iii):** US Air Force. **(iv):** US Air Force.

WAR MACHINE

Forthcoming issues feature:
1950s Carrier Aircraft
Heavy Artillery of World War I
Modern Wheeled APCs
Supersonic Fighters
Modern Support Vessels

Soviet and American Tanks of World War 11

The Soviet KV-1 heavy tank seen here in 1939 was one of the most powerful in service at the outbreak of war. Constant development was to lead to the potent IS-2 by 1945.

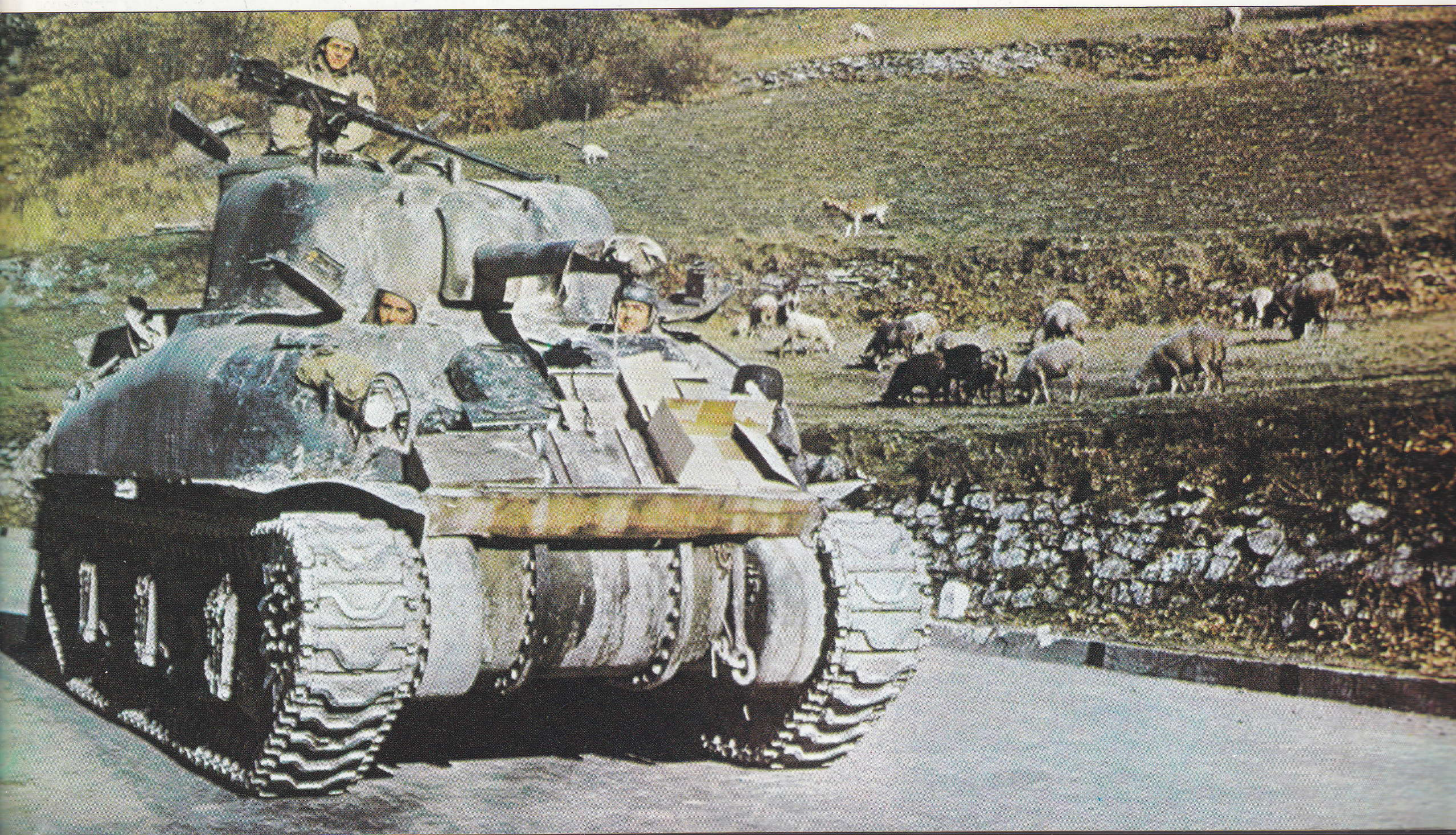
Nowhere in the course of World War II was the industrial might of what were to become the superpowers more evident than in the production of armoured vehicles. Manufacture of such war-winning weapons as the M4 Sherman and the Soviet T-34 was on a scale that the Axis could not hope to match.

The tanks described here include some of the best known names of World War II. In these pages will be found the Sherman, the T-34, the Lee and the Grant, but also included are some slightly lesser known names. Few outside the Soviet Union can be familiar with the little T-70 light tank, but in its day it was numerically an important part of the Red Army tank fleet, along with the almost equally unknown T-26.

The numbers and fame of the T-34 and the various Shermans have tended to obliterate the fact that between 1939 and 1945 there were many types of tank lurching around the battlefields. Despite the needs for harsh standardization to boost mass production totals, no combatant was able to say at any time that only one specific tank type would be produced. Constant supply and demand fluctuations prevented any such thing, although at one point the Soviets got very close to it with the T-34. Also, tanks were generally retained in service for as long as possible, sometimes until they had been outdated or rendered obsolete by events. Thus the M3 series of American light tanks carried on right through the war, long after there was no longer a place on the battlefield for their original services.

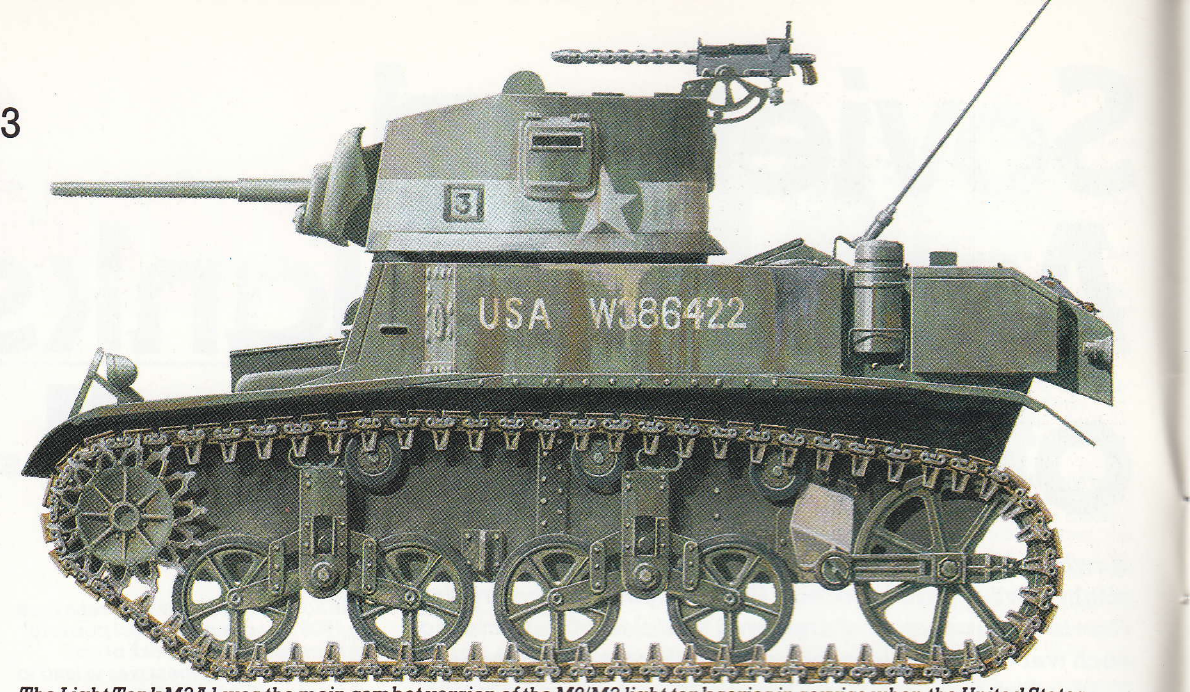
But if any of the tanks tend to overshadow their fellows they must be the Sherman and the T-34. Together they made major contributions to the final Allied victory over Germany, and so ensured that their names were recorded in history. Both had their faults. The T-34 was cramped inside and manufactured to a standard that was almost crude. The Sherman was high, lacked armour protection and was almost constantly undergunned. But both types possessed the key factor of mobility and availability, and in war these can go far towards tipping the balance of fortune towards one side or another. By 1944 both the T-34 and the Sherman were instrumental in forcing the German army back towards the borders of its homeland, and for that alone they will always be remembered.

An American M4 Sherman heads towards the Gothic Line in Italy. In spite of a certain vulnerability to the larger enemy tanks, the Sherman was produced in extremely large numbers, and those numbers proved decisive.



USA

Light Tank M3



The Light Tank M3A1 was the main combat version of the M2/M3 light tank series in service when the United States entered the war in late 1941. It mounted a 37-mm (1.456-in) main gun, and there was provision for three machine-guns.

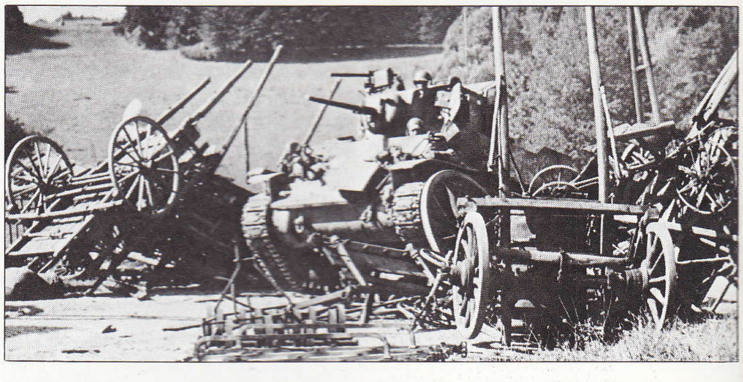
American light tank development can be traced back to the 1920s when several infantry-support light tanks were developed in small numbers. By the early 1930s these designs had evolved into the **Light Tank M2**, and there were a series of designs all using the M2 designation. For its day this series were quite well armed, with a 37-mm (1.46-in) main gun, but by 1940 the type was at best obsolescent and was used only for training after reaching its apogee with the **M2A4** model.

The events of 1940 in Europe were followed closely by the US Army, which realized that thicker armour would be required by its light tanks. This involved a better suspension to carry the extra weight and the result was the **Light Tank M3**, based generally on the M2A4. It was in full-scale production by 1941, and mass production of the **M3A1** really got under way once the USA had entered the war. Early versions used riveted construction, but welded turrets and eventually welded hulls were successively introduced, and there were also many detail design changes. By the time M3 production ceased 5,811 had been built. Basic armament of the M3A1 was one 37-mm (1.46-in) gun with a co-axial 7.62-mm (0.3-in) machine-gun, and four other 7.62-mm (0.3-in) machine-guns (one on the turret roof for AA defence, one in the hull front and two fixed in the sponsons for operation by the driver). Armour thickness ranged from 15 mm (0.59 in) to 43 mm (1.69 in).

The Light Tank M3 was used wherever the US Army was involved. It proved to be a thoroughly reliable vehicle and was greatly liked by its crews. Large numbers of M3s were passed to the USA's allies, and the largest recipient was the UK, where the M3 was known as the **Stuart**. To British eyes the Stuart was large for a light tank, but crews soon learned to appreciate the nippiness and reliability of the vehicle. One thing they did not particularly like was the fact that two main types of engine were fitted to different versions: the normal engine was a Continental 7-cylinder radial petrol engine (**Stuart I**), but in order to expedite production at a time of high demand the Guiberson T-1020 diesel engine was substituted (**Stuart II**). This sometimes caused logistic supply problems but it was a burden the Allies learned to survive. Major variants were the **M3A1** (**Stuart III** and **Stuart IV** with petrol and diesel engines) fitted with a gyrostabilized gun, power-traverse turret and turret basket, and the product-improved **M3A3** (**Stuart V**) with a larger driving compartment, thicker armour and no sponson guns.

The 37-mm (1.46-in) gun was retained throughout the production life of the M3. By 1944 it had very little combat value, so many M3s and Stuarts serving with reconnaissance units had the turret removed to assist concealment. Extra machine-guns were carried instead. Many of these turretless M3s were employed as command vehicles by armoured formation commanders but these were not the only variations upon the M3 theme. The M3 was widely used for all manner of experiments that ranged from mine-clearing expedients to flame-throwers of several kinds. Some vehicles were used for carrying self-propelled artillery, but none were accepted for service. There was even an anti-aircraft version.

With the Allies the M3/Stuarts were used from the North African campaign onwards. Some were passed to the Red Army under Lend-Lease arrangements. The **Light Tank M5** was a development powered by twin Cadillac engines that was otherwise generally similar to the M3 series but was recognizable by the raised rear decking that accommodated the twin engines. In British service the M5 was the **Stuart VI**, the same designation being used for the **M5A1** with an improved turret having a bulged rear for radio (as on the M3A3).



The M3 (and the M5) series were used by many Allied armies for reconnaissance. This example is seen negotiating an improvised German roadblock outside Harze in Belgium during the late summer of 1944.

Specification

Light Tank M3A1

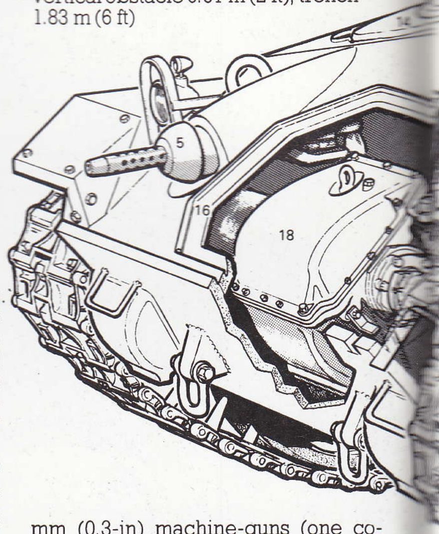
Crew: 4

Weight: in action 12.927 tonnes

Powerplant: one Continental W-970-9A 7-cylinder radial petrol engine developing 186.5 kW (250 hp)

Dimensions: length 4.54 m (14 ft 10.75 in); width 2.24 m (7 ft 4 in); height 2.30 m (7 ft 6.5 in)

Performance: maximum road speed 58 km/h (36 mph); maximum road range 112.6 km (70 miles); fording 0.91 m (3 ft); gradient 60 per cent; vertical obstacle 0.61 m (2 ft); trench 1.83 m (6 ft)



USA

Light Tank M24 Chaffee

By 1942 it was evident that the day of the 37-mm (1.46-in) tank gun had passed, and requests were coming from the field for a light tank with a 75-mm (2.95-in) main gun. Attempts to fit such a gun into the Light Tank M5 were unsuccessful, so a new design was started by Cadillac. The first was ready by late 1943 and it carried over several features of the M5, including the twin engines, but the main change was to the turret and gun.

The new turret mounted the required 75-mm (2.95-in) gun, whose development was lengthy. Originally it had been the old French '75' field gun altered for use in tanks. Various efforts were made to lighten the gun to the extent that it could be mounted in B-25 bomber aircraft for anti-shipping use, and in this form the T13E1 was easily adapted as a light tank weapon.

The new light tank was initially known as the **T24** but when accepted for service it became the **Light Tank M24** and was later given the name **Chaffee**. It was not in full service until late 1944, and thus was able to take only a small part in the fighting in Europe during 1945. Perhaps its biggest contribution was not really felt until the war was over, for the M24 was designed to be only a part of what the designers called a 'combat team' of armoured vehicles. The idea was that a common chassis could be used to provide the basis for a whole family of armoured vehicles that included self-propelled artillery, anti-aircraft tanks, and so on. In fact this concept did not make the impresion that it might have done as the war ended before it could be put into full effect, and indeed the M24 did not make its full combat impact until the Korean War of the early 1950s.

The M24 was a good-looking little tank, well armed for its size and weight, but the armour (minimum 12 mm/0.47 in and maximum 38 mm/1.5-in) had to be lighter than in heavier tanks to give the vehicle its agility. The M24 had a surprisingly large crew of five men (commander, gunner, loader, radio operator who sometimes acted as assistant driver, and driver). Apart from the main gun there were two 7.62-mm (0.3-in) machine-guns (one co-axial with the main gun and one in the front hull) and a 12.7-mm (0.5-in) gun on the turret mounted on a pintle. To add to this array there was a 51-mm (2-in) smoke mortar. All this was a considerable armament for a vehicle with a tactical responsibility that was li-

Light Tank M24 Chaffee (continued)

mited mainly to reconnaissance, but by the time the M24 entered service it was a luxury that the Americans could well afford.

As mentioned above, the M24 went on to make its greatest impact after 1945 and many nations retain the M24 to this day, several of them going to the trouble of re-engining the vehicles and updating their fire-control systems.

Specification

Light Tank M24

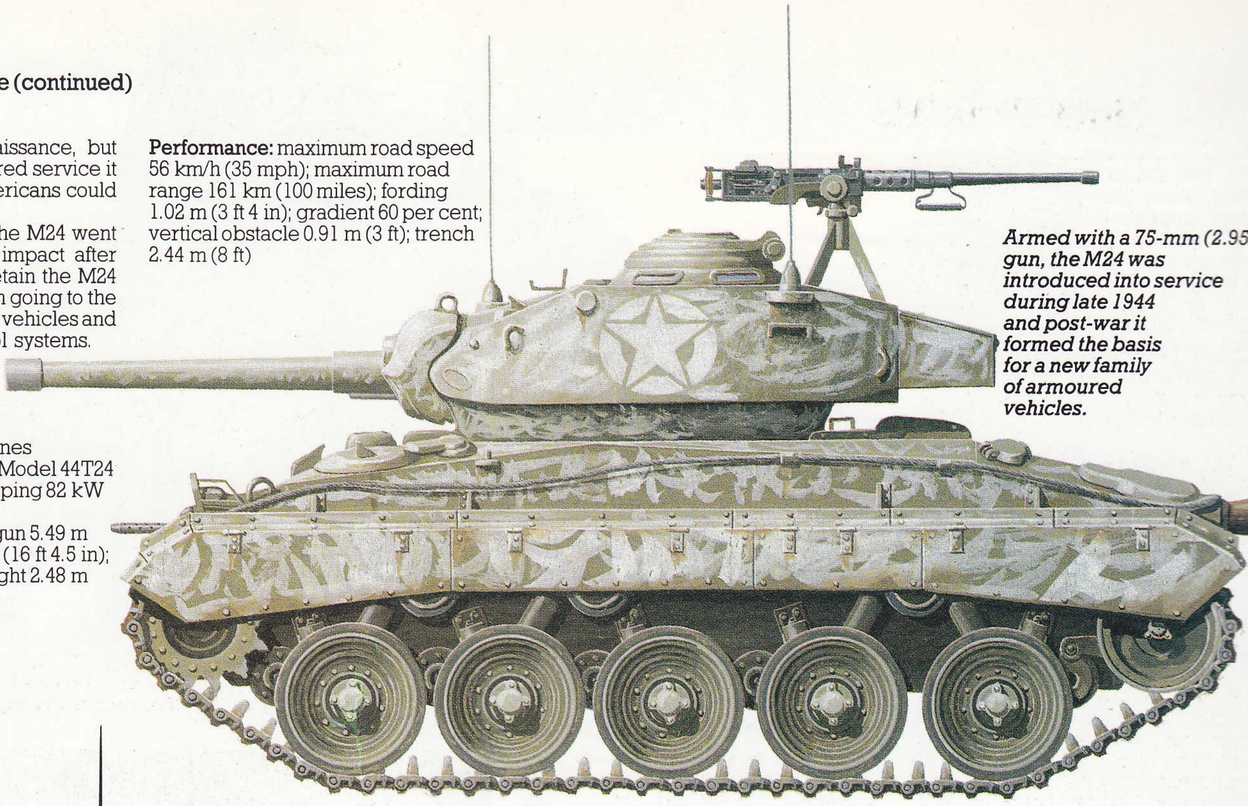
Crew: 5

Weight: in action 18.37 tonnes

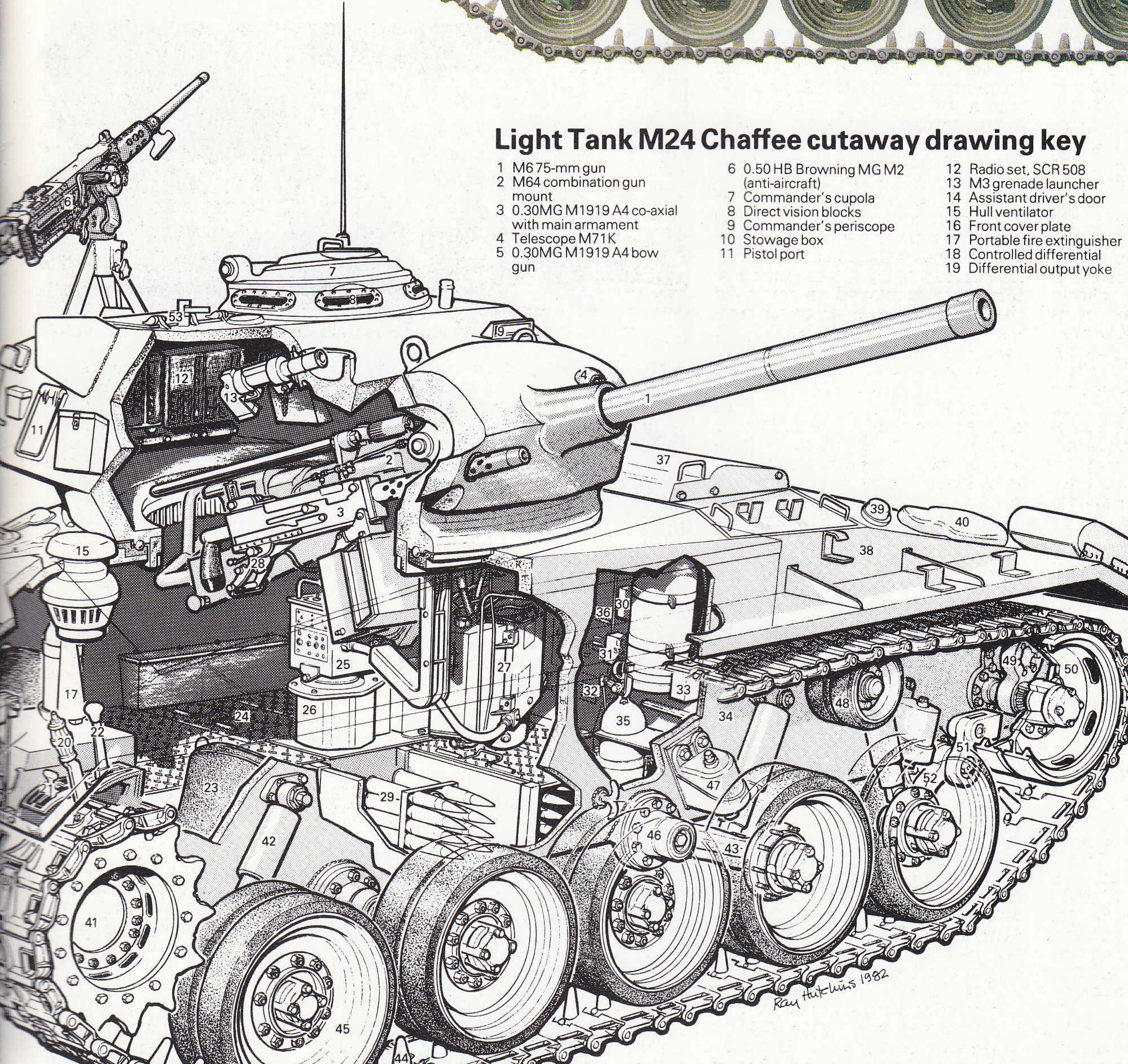
Powerplant: two Cadillac Model 44T24 V-8 petrol engines developing 82 kW (110 hp) each

Dimensions: length, with gun 5.49 m (18 ft) and over hull 4.99 m (16 ft 4.5 in); width 2.95 m (9 ft 8 in); height 2.48 m (8 ft 1.5 in)

Performance: maximum road speed 56 km/h (35 mph); maximum road range 161 km (100 miles); fording 1.02 m (3 ft 4 in); gradient 60 per cent; vertical obstacle 0.91 m (3 ft); trench 2.44 m (8 ft)



Armed with a 75-mm (2.95-in) gun, the M24 was introduced into service during late 1944 and post-war it formed the basis for a new family of armoured vehicles.

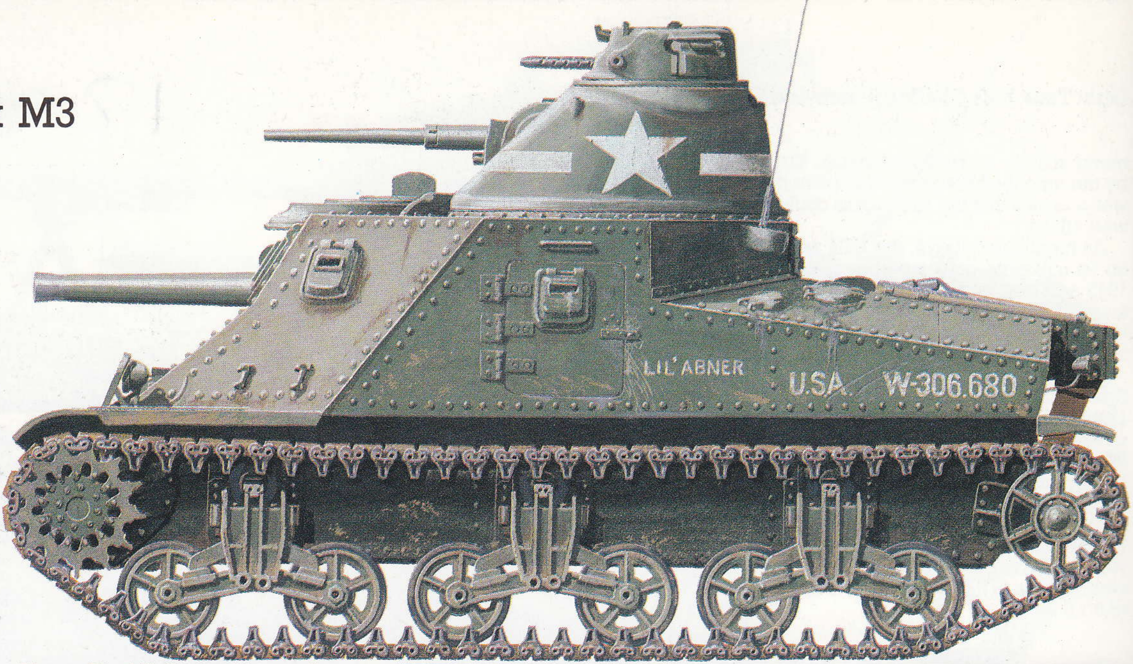


Light Tank M24 Chaffee cutaway drawing key

1 M6 75-mm gun
2 M64 combination gun mount
3 0.30MG M1919 A4 co-axial with main armament
4 Telescope M71K
5 0.30MG M1919 A4 bow gun
6 0.50 HB Browning MG M2 (anti-aircraft)
7 Commander's cupola
8 Direct vision blocks
9 Commander's periscope
10 Stowage box
11 Pistol port
12 Radio set, SCR 508
13 M3 grenade launcher
14 Assistant driver's door
15 Hull ventilator
16 Front cover plate
17 Portable fire extinguisher
18 Controlled differential
19 Differential output yoke
20 Driver's hand levers (steering brake)
21 Range selector/ transmission lever
22 Hand lever transfer unit shift control
23 Driver's seat
24 Fire escape hatch door
25 Turret control box
26 Turret driving mechanism
27 Stabilizer and turret motor
28 Firing solenoid
29 Ammunition storage boxes
30 Left generator regulator
31 Left starter relay
32 Ventilating door
33 Master battery switch
34 Four 6-volt batteries
35 Fixed fire extinguisher
36 Radiator
37 Radiator air inlet grille
38 Two Cadillac 90 V-type 8-cylinder Model 44 T 24 engines
39 Fuel tank covers
40 Fuel compartment vents
41 Final drive sprocket
42 Shock absorber
43 Support arm
44 Track guide
45 Track wheel
46 Torsion bar
47 Bumper spring arm bracket
48 Track support roller
49 Compensating wheel and track wheel support linkage
50 Track compensating wheel
51 Compensating wheel link
52 Track wheel link
53 Loader's hatch

USA

Medium Tank M3



Above: The M3 General Lee tank was a hasty design, but it had a powerful 75-mm gun which gave Allied tanks a parity with German tanks for the first time.

When the Germans invaded France in May 1940 the consequent tank actions were closely observed by various US Army agencies. From their observations the Americans learned that the next generation of medium tanks had to have at least a 75-mm (2.95-in) gun as their main armament, but this presented them with problems as their next tank generation, already being produced in prototype form, was armed with only a 37-mm (1.46-in) gun of the type already seen to be obsolete.

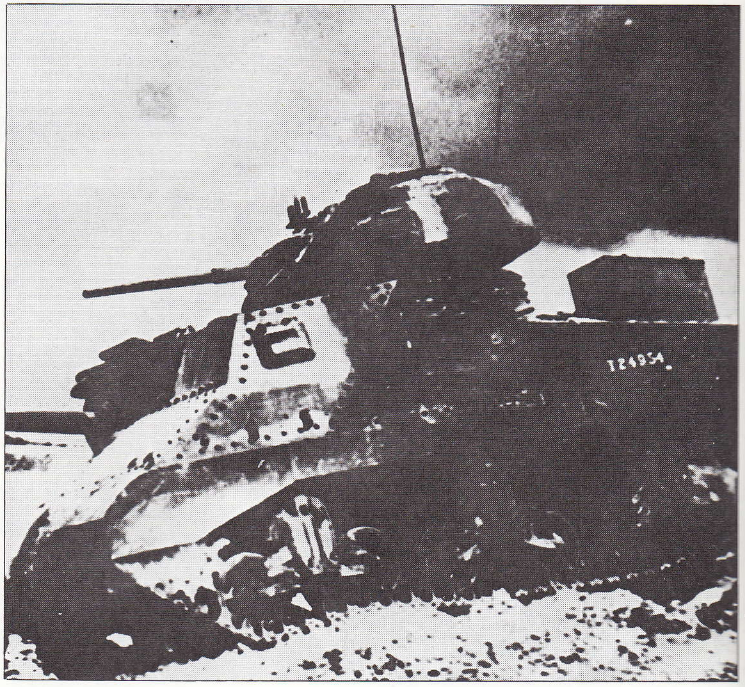
The American answer was swift and drastic: they simply took their existing design and altered it to accommodate the required 75-mm (2.95-in) gun. The turret of the new design (the **Medium Tank M2**, destined never to see active service) could not take the larger gun so the weapon had to be situated in the hull. Consequently the revised tank design retained the 37-mm (1.46-in) gun turret, while the main armament was located in a sponson on the right-hand side of the hull. The 75-mm (2.95-in) gun was a revised version of the famous French '75' field piece as made in the USA, but new ammunition converted it into what was for the time a powerful tank weapon. Secondary armament comprised four 7.62-mm (0.3-in) machine-guns (one in the commander's cupola atop the 37-mm/1.46-in turret, one co-axial with the 37-mm/ 1.46-in gun, and two in the hull).

The new design became the **Medium Tank M3**, and was rushed into mass production in a factory meant for the earlier M2. Almost as soon as production started for the US Army, a British mission arrived in the United States on a purchasing trip to obtain tanks to replace those lost in France, and the M3 was high on its shopping list. They requested a few changes to suit their requirements, the most obvious of which were a revised turret rear outline to accommodate radio equipment and the absence of the cupola and this model was produced specifically for the British army. Once delivered the British knew the M3 as the **General Grant I** (or simply **Grant I**), and the first of them went into action at Gazala in May 1942 when they provided the Afrika Korps with a nasty fright as their arrival was entirely unexpected, their combination of armament and armour (12 mm/0.47 in minimum and 50 mm/ 1,97 in maximum) proving most useful.

The Grants were later joined in British service by the unmodified M3 which was then labelled the **General Lee I**. Further improvement led to the **M3A1** (**Lee II**) with welded construction, the uparmoured **M3A3** (**Lee IV**) with two General Motors 6-71 diesels delivering 375 hp (280 kW), the **M3A4** (**Lee V**) with the Chrysler A-57 multibank engine delivering 370 hp (276 kW), and the **M3A5** based on the M3A3 but with a riveted hull. By the time production ended in December 1942 the total had reached 6,258 and the M3 was used in virtually every theatre of war in one form or another. Many were passed to the Red Army on a Lend-Lease arrangement.

The M3 turned out to be a reliable and hard-wearing vehicle, but its hull-located main gun was often a cause of tactical difficulties as its traverse was very limited. But it did provide the punch that Allied 'tankies' required at that time. Its tactical silhouette was really too high for comfort, but considering that the basic design was improvized and rushed into production, at a time when there were more questions being asked than answers provided, it turned out to be a remarkable effort. Many of the suspension and automotive features were later incorporated into other designs and continued to provide excellent service, but perhaps the main lesson to be learned from the M3 was the latent power of American industry that could churn out such a vehicle from scratch in such a short time.

As soon as the M4 entered service the M3s were usually withdrawn and converted to other roles such as armoured recovery vehicles, but in the Far East they remained in use until 1945 in both Grant and Lee forms.



The M3 Grant was the 'British' version of the M3 Lee. The main change was to the turret profile, which had a rear overhang to house a radio set, and the silhouette was lowered by omitting the machine-gun cupola of the original turret.

Specification

Medium Tank M3A2
Crew: 6
Weight: in action 27.24 tonnes
Powerplant: one Continental R-975-EC2 radial petrol engine developing 253.5 kW (340 hp)
Dimensions: length 5.64 m (18 ft 6 in); width 2.72 m (8 ft 11 in); height 3.12 m (10 ft 3 in)
Performance: maximum road speed 42 km/h (26 mph); maximum road range 193 km (120 miles); fording 1.02 m (3 ft 4 in); gradient 60 per cent; vertical obstacle 0.61 m (2 ft); trench 1.91 m (6 ft 3 in)

USA

Medium Tank M4

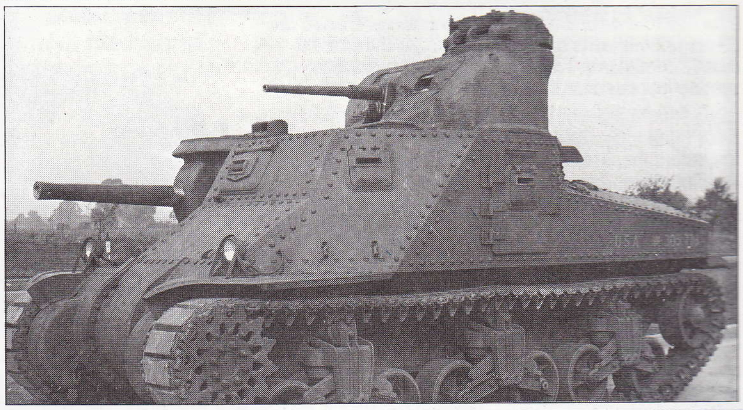
While the Medium Tank M3 was being rushed into production, a new design of medium tank with a turret-mounted 75-mm (2.95-in) main gun was being pushed through the drawing board stages. To save time this was to use the same basic hull and suspension as the M3, but the upper hull was revised to accommodate the gun turret. The first example of the new tank was rolled out in September 1941 as the **Medium Tank T6** and proved to be a very good design. The upper hull was cast, and this not only provided added protection but speeded production, at that time a definite asset.

The new weapon was rushed into production as the **Medium Tank M4**, with a 75-mm (2.95-in) main gun and co-axial 7.62-mm (0.3-in) machine-gun, 7.62-mm (0.3-in) bow gun and 12.7-mm (0.5-in) gun for AA defence. This baseline model had minimum and maximum armour thicknesses of 15 mm (0.59 in) and 76 mm (2.99 in) respectively. It proved to be an excellent fighting platform and went on to be one of the war-winning weapons of the Allies, being constructed in thousands. By the time the production lines stopped rolling in 1945 well over 40,000 had been made, and the type was built in a bewildering array of marks, submarks and variants of all kinds. There is no space in these pages even to attempt a complete listing of all the numerous versions, but suffice to say that once in service the M4 series was differently engined: up-gunned to even more powerful 75-mm (2.95-in), 76-mm (2.99-in) and 105-mm (4.13-in) main weapons; and developed into numerous 'specials' such as engineer tanks, assault tanks, tank destroyers, flamethrowers, bridging tanks, recovery vehicles, rocket launchers, self-propelled artillery carriages, anti-mine vehicles and so on, which were produced from scratch or improvised in the field. Gradually the M4 series became the T-34 of the Western Allies.

The British army purchased large numbers of M4s or took them over as part of the Lend-Lease programme. To the British the M4 was the **General Sherman** (or simply **Sherman**) and they

Tank Armament 1918-1945

The armament carried by tanks changed extensively from the end of the Great War. Initially infantry support weapons, armed with conventional artillery pieces, the tank developed a new role as destroyer of other tanks. Hence armour-piercing capability came to be the prime requirement of the tank gun.



The turret gun of the M3 Lee medium tank is typical of tank armament in the years prior to World War II. The 37-mm weapon was soon found to have insufficient power to deal with the new thickness of armour appearing in Europe. As a stopgap the Americans provided their new tank with a sponson mounted 75-mm gun which proved reasonably effective.

The tanks of World War I were fitted with whatever armament was to hand when they were designed. For the British that meant modified naval 6-pdr guns, for the Germans the very similar 57-mm (2.244-in) gun and for the French the famous '75'. Between the wars relatively little happened in the way of armament development, and the few innovations were introduced at a steady pace.

The first guns designed from the outset for tank use were developed in conjunction with towed anti-tank guns. They used almost identical barrels and fired essentially similar ammunition. Typical of these was the German 37-mm (1.46-in) gun from Rheinmetall. Introduced during the late 1920s, at a time when Germany was supposed to have no tanks, the 37-mm (1.46-in) gun had a relatively long barrel and fired a solid shot. The shot was propelled by a comparatively powerful charge and the long barrel gave the propellant gases enough time to build up to a great pressure and so force the projectile out of the muzzle at high velocity. On arrival at the target armour the combination of the dense shot and the energy derived from its mass and velocity combined to punch a hole through the armour into the tank interior, where it was supposed to bang around causing considerable damage.

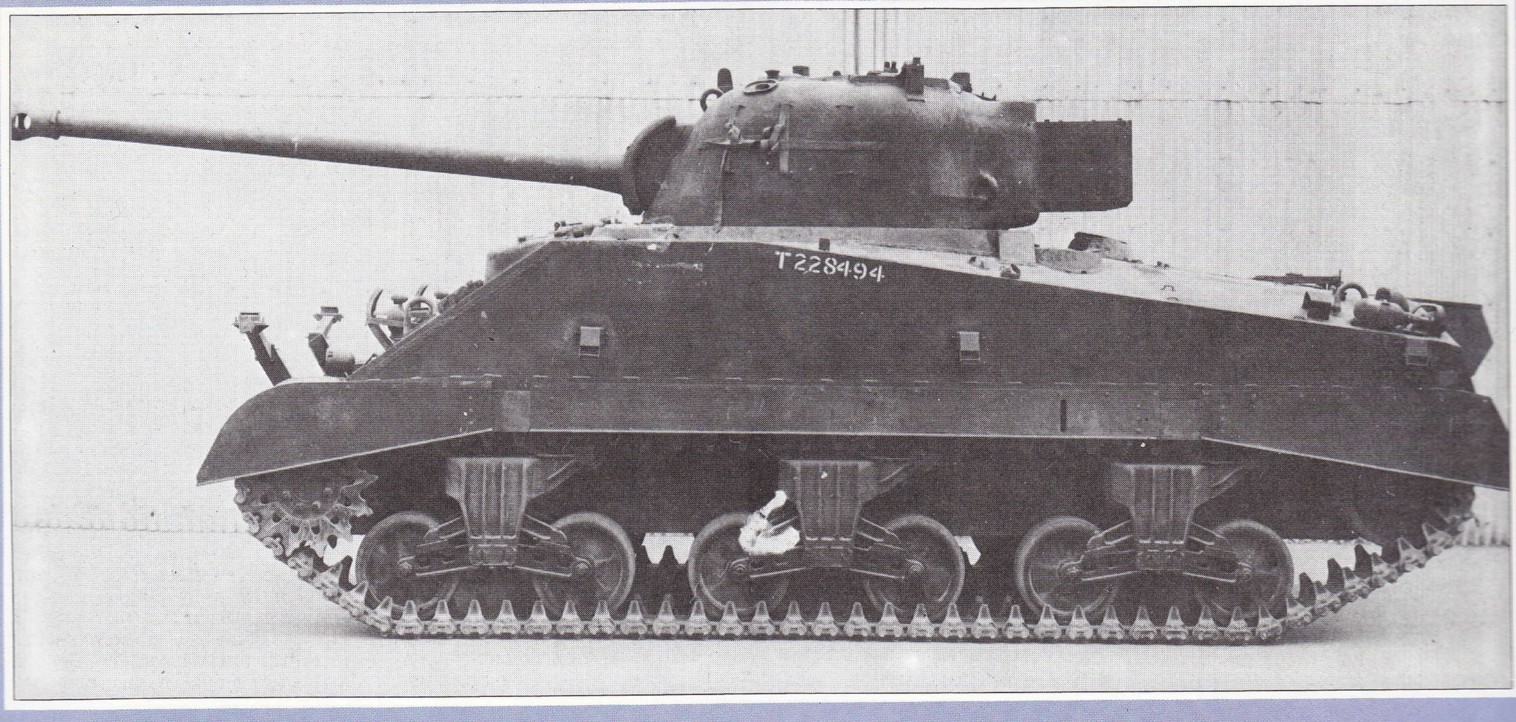
In 1939 nearly all the tank guns in service relied on this simple principle. The Germans and the Americans both used very similar guns on most of their tanks, while the French relied on a heavier 47-mm (1.85-in) calibre working on the same principle. Some French tanks used short-barrelled guns developed from the trench guns of World War I. These had only limited anti-armour capability, and the same could be said of the short 75-mm (2.95-in) guns fitted to some German and French heavy tanks. Only the Soviet Union had any really heavy tank guns, for even in 1940 they were fitting high-velocity 76.2-mm (3-in) guns to their new designs.

All these guns relied upon kinetic energy (i.e. force) for their effectiveness. But by 1940 there was available a new form of anti-armour weapon that used chemical energy. This is the hollow-charge shell, which generates a forward-moving jet of high-temperature gas and vaporized metal as it strikes the targets's armour. The jet of flame literally burns or melts its way through the armour to set fire to the interior, and for a while this type of round seemed to have definite advantages over the kinetic-energy projectile. This period lasted for some years before it was fully appreciated that hollow-charge warheads were most effective at low terminal velocities and the weapons that produced these velocities generally lacked the range or the horizontal flight paths that tank gunners required. So it was back to the kinetic-energy gun.

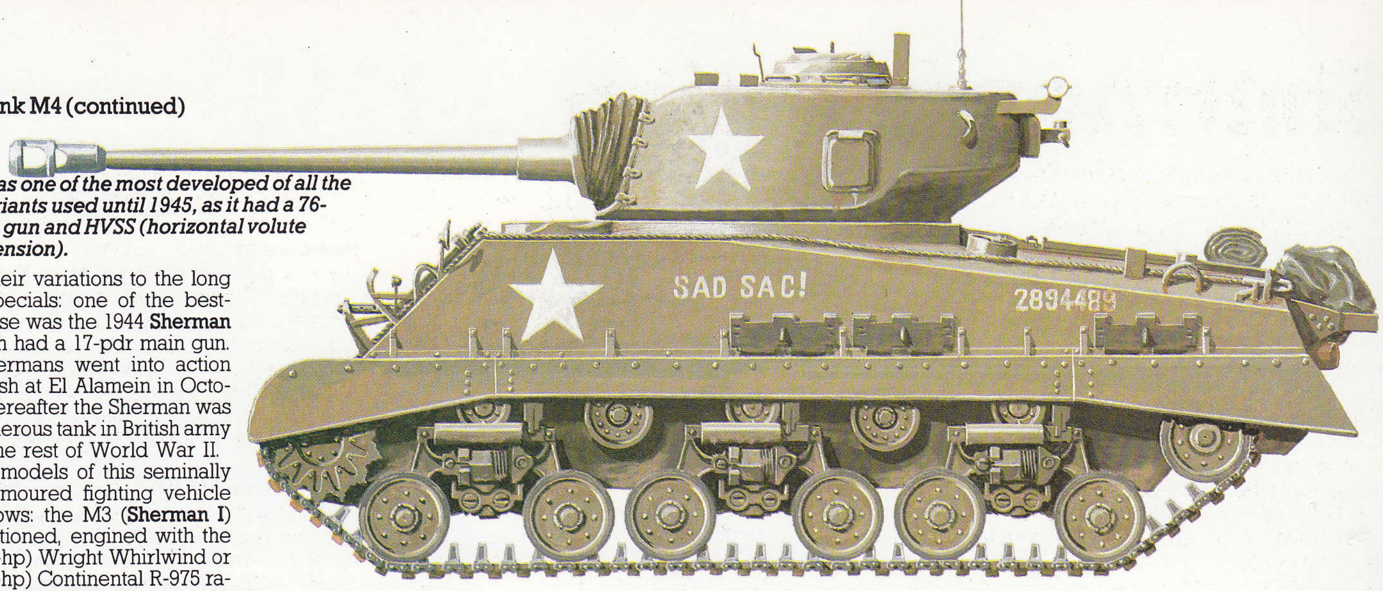
The main problem for the gun was that between 1940 and 1945 tank armour increased in leaps and bounds. To give an example from the German stable, the early PzKpfw II had bow armour that was 30 mm (1.18 in) thick, whereas only a few years later the PzKpfw VI Tiger II had massive 100-mm (3.94-in) frontal armour. The small tank guns were unable to make any impression whatsoever upon such thick carapaces, so the only solution was to design and produce guns that were larger in calibre to fire a larger shot, and longer in the barrel to increase the muzzle velocity even further. Tungsten was introduced to provide a denser projectile that could impart yet more kinetic energy, and all manner of ballistic ploys were devised to ensure that the metal of the projectile would not shatter on impact. Ballistic caps for the projectile nose were one common solution to this phenomenon.

Thus gun calibres increased from the original 37 mm (1.46 in) to around 50 or 57 mm (1.97 or 2.24 in), but this turned out to be only an interim solution until the 75-mm (2.95-in) or 76.2-mm (3-in) bracket was reached. Even this was not enough for the Germans and the Soviets, who went one better still and built 88-mm (3.46-in) and 85-mm (3.35-in) guns respectively. It was around this point that physical laws made themselves felt, and it was soon learned that simply increasing the projectile size did not necessarily produce an increase in armour-penetration power: a 75-mm (2.95-in) projectile fired at a high velocity could have better penetration characteristics than the equivalent 88-mm (3.46-in) projectile, but the 88-mm (3.46-in) shot could maintain its power over longer ranges. And by 1945 operational ranges for tank combat had increased from the short 200 or 300 m (220 or 330 yards) of 1940 to well over 2000 m (2,185 yards) by 1945. Thus the big gun ruled. By 1945 the Soviets had placed 100-mm (3.94-in) guns into tank destroyers and a 122-mm (4.8-in) monster into the turret of the IS-2. These were exceptions. The Allies had decided upon 76.2-mm (3-in) as being the maximum practical limit for their medium tanks and it was left to the M26 heavy tank to carry the 90-mm (3.54-in) gun that was the largest in-service tank gun in the Allied armies. The Germans stuck to the '88', and in the 8.8-cm KwK 43 they had what was perhaps the best all-round tank gun of the war years.

By 1944, the standard 75-mm gun fitted to the M4 Sherman was considerably outclassed by the armour appearing on German Tiger and Panther tanks. The British solution was to fit the heaviest possible anti tank gun to the Sherman. The resulting 17 Pounder armed tank was known as the Sherman Firefly, and proved to be the only Allied tank capable of knocking out the Panzers from a reasonable distance during the battle for Normandy.



Medium Tank M4 (continued)



The M4A3 was one of the most developed of all the Sherman variants used until 1945, as it had a 76-mm (2.99-in) gun and HVSS (horizontal volute spring suspension).

too added their variations to the long list of M4 specials: one of the best-known of these was the 1944 **Sherman Firefly**, which had a 17-pdr main gun. The first Shermans went into action with the British at El Alamein in October 1942. Thereafter the Sherman was the most numerous tank in British army service for the rest of World War II.

The main models of this seminally important armoured fighting vehicle were as follows: the M3 (**Sherman I**) already mentioned, engined with the 263-kW (353-hp) Wright Whirlwind or 298-kW (400-hp) Continental R-975 radial engines; the **M4A1** (**Sherman II**) with a fully cast rather than cast/welded hull, and alternatively engined with the 336-kW (450-hp) Caterpillar 9-cylinder diesel; the **M4A2** (**Sherman III**) with a welded hull and a 313-kW (420-hp) General Motors 6-71 twin-diesel powerplant; the **M4A3** (**Sherman IV**) with a 373-kW (500-hp) Ford GAA III engine and horizontal- rather than vertical-volute suspension; and the **M4A4** (**Sherman V**) with the 317-kW (425-hp) Chrysler five-bank engine. It is also worth noting that in British service the mark numbers were suffixed whenever the main armament was not the standard 75-mm (2.95-in) gun, A indicating a 76-mm (2.99-in) gun, B a 105-mm (4.13-in) howitzer and C a 17-pdr anti-tank gun. The suffix W in US designations denoted the provision of wet ammunition stowage for reduced fire risk. Armour protection was also considerably developed in the lengthy production run, the M4A2 having a minimum and a maximum of 13 and 105 mm (0.51 and 4.13 in), equivalent figures for the M4A3 and M4A4 being 15 and 100 mm (0.59 and 3.94 in), and 20 and 85 mm (0.8 and 3.35 in) respectively.

It was the numerical superiority of the M4 that in the end made it a war-winner. The M4 had many drawbacks and was far from being the ideal battle tank. It was often left behind in fire-power as the German tank guns increased in power and calibre, and the armour thicknesses and arrangement were frequently found wanting. Indeed many field improvizations had to be used to beef up the armour, these including the simple expedient of using stacked sandbags. The silhouette was too high for comfort and the interior arrangements far from perfect. Another problem frequently encountred was that with so many variants in use spares were often not available and engine interchangeability was frequently impossible, causing considerable logistical troubles.

Specification
Medium Tank M4A3
Crew: 5
Weight: in action 32.284 tonnes
Powerplant: one Ford GAA V-8 petrol engine developing 335.6 or 373 kW (450 or 500 hp)
Dimensions: length, with gun 7.52 m (24 ft 8 in), and over hull 6.27 m (20 ft 7 in); width 2.68 m (8 ft 9.5 in); height 3.43 m (11 ft 2.875 in)
Performance: maximum road speed 47 km/h (29 mph); maximum road range 161 km (100 miles); fording 0.91 m (3 ft); gradient 60 per cent; vertical obstacle 0.61 m (2 ft); trench 2.26 m (7 ft 5 in)

USA

Heavy Tank M26 Pershing

The heavy tank did not have an easy time during World War II as far as the Americans were concerned. Early on they realized the operational need for a heavy tank but initially concentrated their considerable production potential on the medium tank, the M3 and M4 series in particular. A promising design, the **Heavy Tank M6**, came to nought as the result of this concentration of effort, but low-priority development facilities were thereafter accorded to the heavy tank. This requirement was emphasized when the German Panther and Tiger arrived on the battlefield, and the heavy tank was then given a greater degree of priority.

The first of the new generation of American heavy tanks was a trials model known as the **Medium Tank T20**. It had a 76-mm (2.99-in) gun and used a suspension very like that of the M4 medium tank, but progressive development led to a newer form of suspension of the torsion-bar type. The gun was also replaced by a new 90-mm (3.54-in) main gun in a revised turret, and after a further series of trials models culminating in the **Heavy Tank T26E3** (via the **Medium Tanks T22, T23, T25** and **T26**) was selected for production as the **Heavy Tank M26**. It was given the name **General Pershing** (or simply **Pershing**), but by the time the full series of trials on the new tank had been completed only a few were ready for action in World War II.

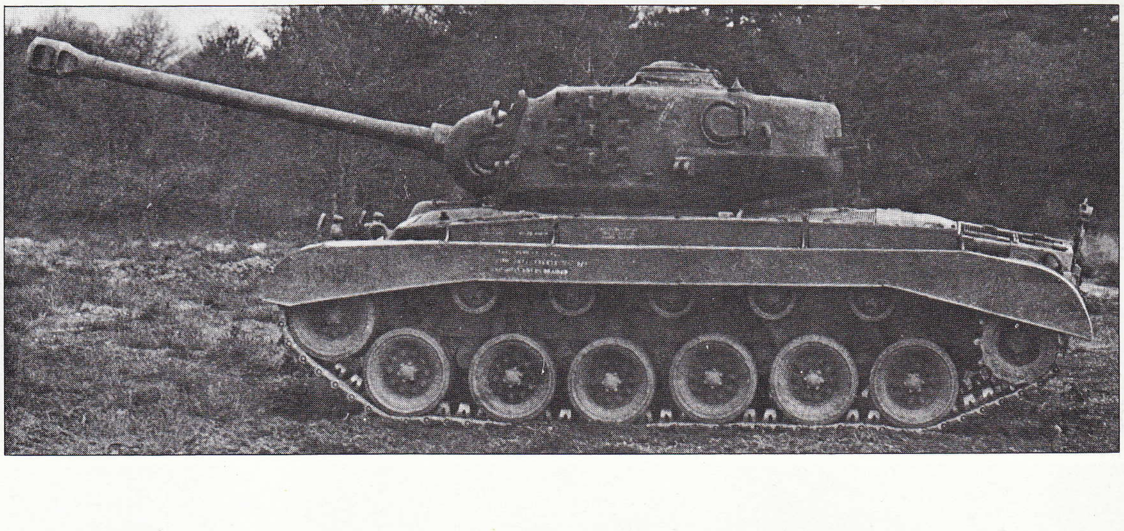
It was early 1945 before the first M26s arrived in Europe and of these only a relative handful saw any action there. More were sent to the Pacific theatre and there rather more were used in anger, but by the time they arrived on the scene there was little a heavy tank could be called upon to perform.

Thus the M26 contributed little to World War II, but its design was the long-term result of the years of combat that had gone before. For perhaps the first time on an American tank adequate consideration was given to armour protection (a minimum of 12 mm/ 0.47 in and a maximum of 102 mm/ 4.02 in) and firepower. With the 90-mm (3.54-in) gun, originally intended for use as an anti-aircraft weapon, the M26 had armament that was the equal of any and the superior of most contemporary tanks. The secondary armament comprised the standard three machine-guns: one 12.7-mm (0.5-in) and two 7.62 (0.3-in) weapons. For all that the M26 still had a few design drawbacks: the turret shape was criticized for its shot-trap potential, and the retention of the bow machine-gun was even then seen as something of an anachronism (later developments did away with it). In fact the M26 was only the start of a new generation of American tank design. After 1945 the M26 was progressively developed through various models including the M47 into the M48 Patton, which is still in widespread service with the US Army and also with other armies all over the world.

The M26 saw extensive action during the Korean War and was for long one of the main types fielded by the US Army in Europe as part of NATO. The M26 also spawned many variants and hybrids as post-war development continued.

Specification
Heavy Tank M26
Crew: 5
Weight: in action 41.73 tonnes
Powerplant: one Ford GAF V-8 petrol engine delivering 373 kW (500 hp)
Dimensions: length, with gun 8.79 m (28 ft 10 in) and over hull 6.51 m (21 ft 2 in); width 3.505 m (11 ft 6 in); height 2.77 m (9 ft 1 in)
Performance: maximum road speed 48 km/h (30 mph); maximum road range 148 km (92 miles); fording 1.22 m (4 ft); gradient 60 per cent; vertical obstacle 1.17 m (3 ft 10 in); trench 2.59 m (8 ft 6 in)

The M26 Pershing mounted a main 90-mm (3.54-in) gun and had a crew of five. It entered service in 1945, just too late to have any major impact on the fighting in Europe but in time to see action during the Okinawa campaign in the Pacific. It was the first of a series leading to the M60 of today.



Sherman in Action

Nobody can doubt that the Sherman medium tank was a war winner, serving in such diverse theatres as the North African desert, on the Eastern Front and in the humid heat of the Pacific war. Made in a host of variants, it overcame a definite inferiority to most German designs to spearhead the Allied defeat of the Third Reich.

The first Shermans to see action were those involved in the battle of El Alamein in October 1942. At that time there were few of these tanks in the Middle East, and those that took part in the subsequent advances across the North African expanse did so in company with the M3 Grants, which at that time were in British service in far larger numbers. The Shermans were versions of the US Medium Tank M4 passed to the British forces, and initially these varied in some ways from the American original. Differences included a revised radio installation, but as more M4s were delivered to the Allies these changes became increasingly blurred to the point where there was little to choose between American and British Shermans.

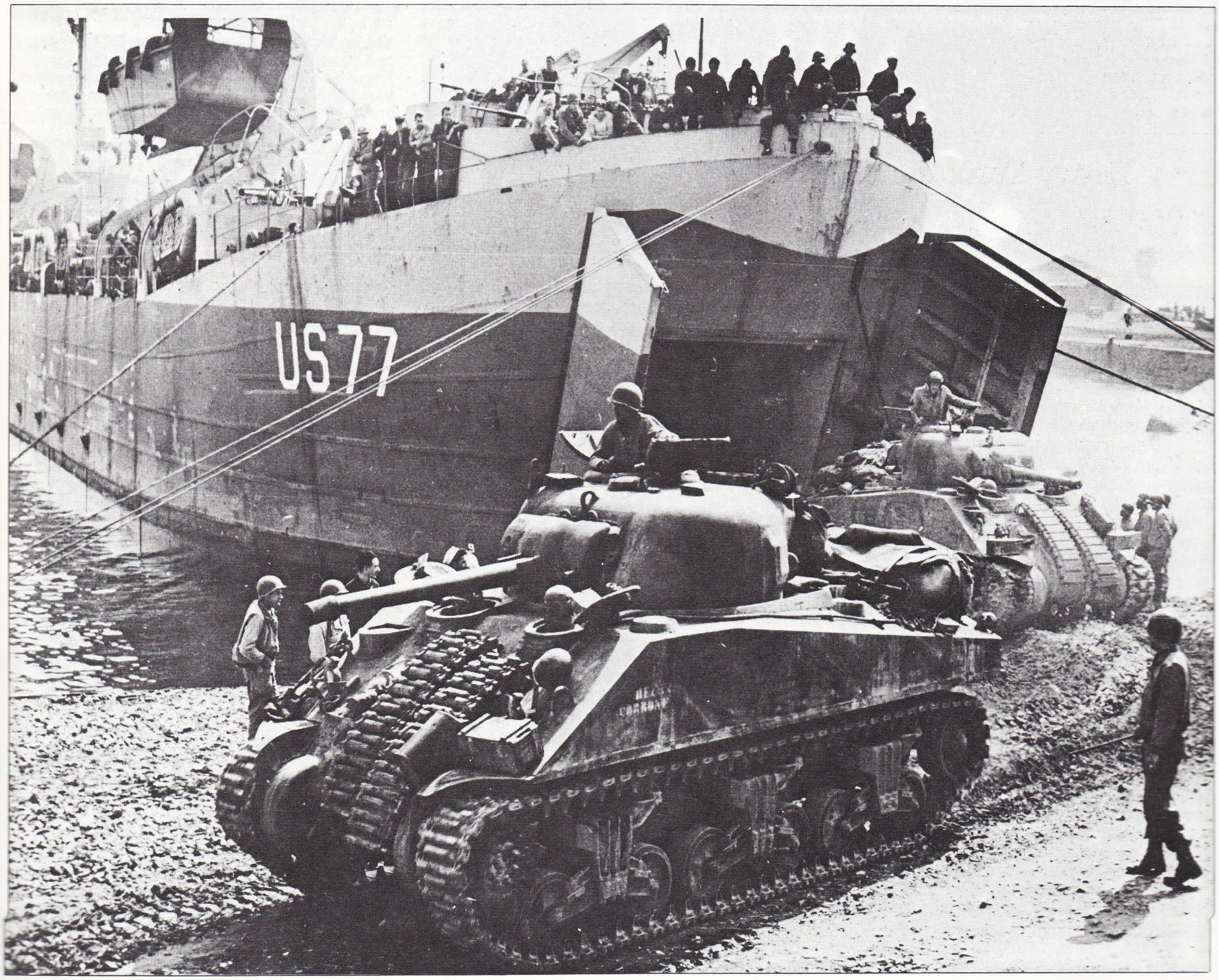
The impact of the first Shermans on the Afrika Korps was considerable. The Germans had only just become used to dealing with the Grant and its awkward sponson-mounted 75-mm (2.95-in) gun when the Sherman, with its turret-mounted 75-mm (2.95-in) gun and 360° traverse, arrived. This gun was capable of dealing with any of the German tanks then in service, but the Germans soon learned that the Sherman had a definite weak point: it was only relatively lightly armoured. Thus a PzKpfw IV could knock out a Sherman without too much difficulty provided it could avoid the attentions of the 75-mm (2.95-in) gun.

This period in the Sherman's career did not last long, for once the chase across the Western Desert was over Tunisia loomed ahead, and with it the prospect of the arrival of the German Tiger heavy tank. The Tiger was known to have exceptionally thick armour and a powerful 88-mm (3.46-in) turret-mounted gun, and the Sherman would obviously be no match for this adversary. Thus there started a one-sided race in which attempts were made to add more armour protection to the Sherman while also trying to upgun the type.

The attempts to provide extra armour were never really achieved. The only sure way to increase armour protection was to provide it at the assembly stage, and this was indeed carried out by using thicker cast armour. Field units attempted to improve matters by the use of welded plates added to the sides of the hull and turret, but these efforts were only partially successful. Many Shermans went into action covered with lengths of spare track shoes or even piled high with layers of sandbags; yet more sandbags lined the interior floor to provide some protection against land mines, as the floor armour of the Sherman was its weakest point.

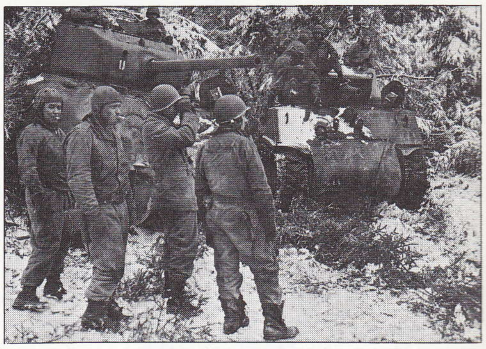
The armament problem was one that could be dealt with only in the design centres and in the factories. The early 75-mm (2.95-in) guns were soon replaced by longer and more powerful 76-mm (2.99-in) guns, but almost as soon as this increase became commonplace in service it was more than countered by the Germans' introduction of the Panther, which

By the time of the Anzio landings, M4 crews had already learned the hard way that the tank's armour was vulnerable to most German anti-tank weapons. All manner of improvised armour was often added, one example being the use of spare lengths of track draped over the hull as seen here.

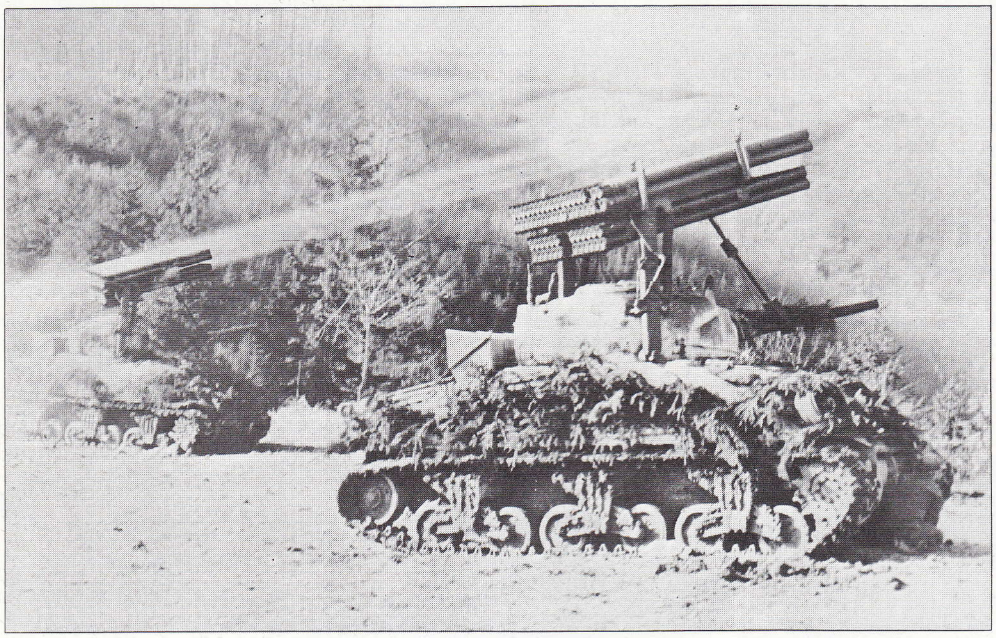


Left: A squadron of US Army M4s assembles for the relief of the Bastogne garrison during early 1945 in the period that followed the initial German thrusts of the Ardennes campaign. The lack of any tactical camouflage demonstrates Allied air supremacy following the earlier German surprises and attacks.

Right: In urban combat situations, tanks with rubble and obstacle-clearing dozer blades are often more use than a gun tank. Most dozer tanks retain their main gun, as does this 1st Army M4 which is busy clearing debris from a street in Kelze in Germany.



Above: By the winter of 1944-5 most US Army M4s had been fitted with 76-mm (2.99-in) main guns. These M4s belong to the 3rd US Armored Division, part of the 1st Army. Despite the snow on the ground these M4s lack any form of camouflage.



Left: The T34 Calliope was a simple and effective conversion of the M4 to carry 60 117-mm (4.6-in) rocket tubes over the turret. This made the vehicle into a formidable close-support weapon, and the rockets were aimed by traversing the turret and elevating the four banks of tubes by raising the gun barrel.

became the main German opposition to the Sherman as the PzKpfw IVs reached the end of their combat development potential. The Panther had a long 75-mm (2.95-in) gun that could easily knock out any Sherman at ranges well in excess of the combat range of even 76-mm (2.99-in) gunned Shermans: the maximum range at which the Sherman could pierce the frontal armour of the Panther was only about 300 m (330 yards), but the Panther could knock out a Sherman at ranges of 1000 m (1,095 yards) or more.

Unfortunately it was not possible at that time to mount any heavier gun on the Sherman hull. When the original M4 had been conceived, the turret ring was designed for a 75-mm (2.95-in) gun only, and anything heavier would have required a much larger turret ring diameter to accommodate the considerable recoil stresses involved on firing. On the Sherman there was quite simply no room to fit a larger turret ring, so the crews had to make do with what they had, and that was the 76-mm (2.99-in) gun. Some Sherman variants were equipped with 105-mm (4.13-in) weapons, but these were modified howitzers with a low muzzle velocity and only limited anti-tank potential. They were intended for 'bunker-busting' and as close support weapons, and were never intended for use as tank destroyers.

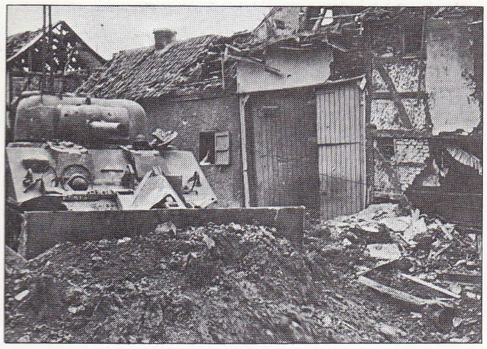
The answer to the immediate problem of the Panther and the Tiger was partially solved by a British development known as the Firefly. This was produced by the installation of the British 17-pdr anti-tank gun barrel into a Sherman turret. The turret ring was only just large enough to take the recoil forces, and internal changes had to be introduced. The 17-pdr had a massive breech block and a considerable recoil length, so the rear of the Sherman turret had to be extended by the addition of an armoured box to accommodate the radio semi-externally. As a bonus the armoured box helped partially to counterbalance the long barrel of the 17-pdr gun. The 17-pdr gun also had a calibre of 76-mm (2.99-in), but it was a much more powerful weapon than the American equivalent, with a higher muzzle velocity and a better combat range.

Firefly tactics

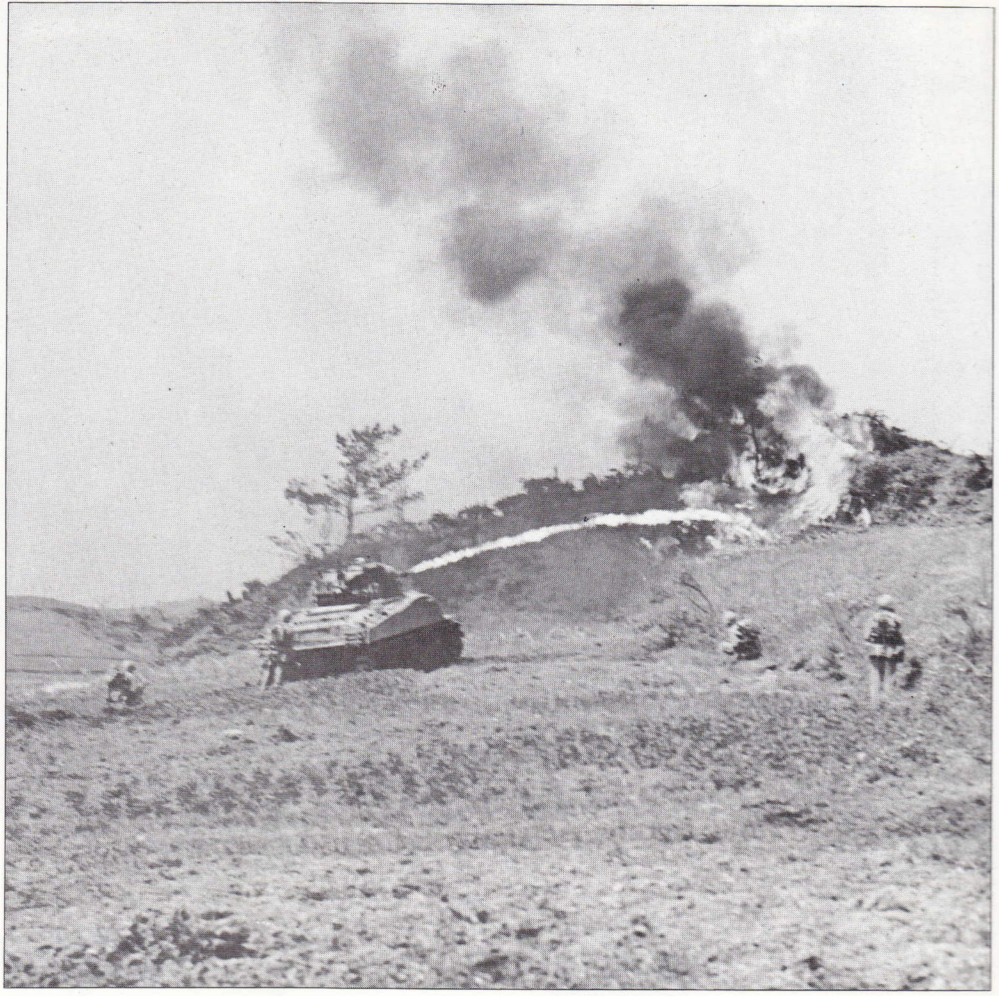
The Firefly came on the scene just in time for the Normandy landings of June 1944. At first Fireflies were in very short supply, and demands for their services constantly outstripped the numbers available: if possible, the arrangement was for one troop of four Shermans to include one Firefly. Thus during the summer of 1944 throughout northern France the spectacle of Shermans prowling around looking for Tigers and Panthers could only be regarded as part of a very dangerous activity. The usual tactic was to deploy a troop of Shermans against isolated Panthers or Tigers. Part of the troop would attempt to distract the attention of their quarry by frontal movements while at least two of the other Shermans, including a Firefly if possible, stalked around a flank to attempt an effective shot. It was a very dangerous game indeed, for the German tanks always had the defensive edge on their hunters and it often cost two or more Shermans for a Tiger or Panther.

On paper the German tanks thus had the advantage over the Shermans, but in action it often worked out that the Shermans gained the upper hand. By 1944 the Allies had many advantages over their enemies. One was the overall supremacy they had in numbers: a knocked-out Sherman was easily replaced, and the crews were often able to survive even the most nasty-looking enemy damage. It was not so for the Germans: every tank they lost was one that could not be replaced without a great deal of difficulty, and by late 1944 the Germans were getting dangerously low in weapons and manpower. The other advantage enjoyed by the Allies was that their war was one of movement: the German Tigers and even the Panthers were relatively ponderous weapons, while the Shermans could always outrun them and strike deep around their flanks to take them from the rear. The magnificent logistic machine that the Allies had established by 1944 frequently enabled them to leave the German heavy armour pinned down for the attentions of aircraft and anti-tank weapons, while the Shermans moved deep into the hinterland of France. And the Shermans kept going, for by 1944 the importance of proper maintenance and the supply of spare parts to fighting units had been fully appreciated. If a German tank broke down, on the other hand, there was often little their crews could do if the problem involved spares, for all too often there were none to hand.

1944 was also the time of another Sherman innovation in armoured warfare. On 6 June 1944



Above: One of the least-known aspects of World War II was the re-arming of the Free French Forces from American sources. These M4s were supplied to the Free French in North Africa, and are seen on parade prior to a training exercise.



Right: There were several versions of M4s fitted with flamethrowers, most of which mounted them in place of the bow machine-gun. This 1st Marine Division M4 on Okinawa in May 1945 used the POA-CWS 75-HI, which mounted the flame gun inside the barrel of an old 75-mm (2.95-in) main gun.

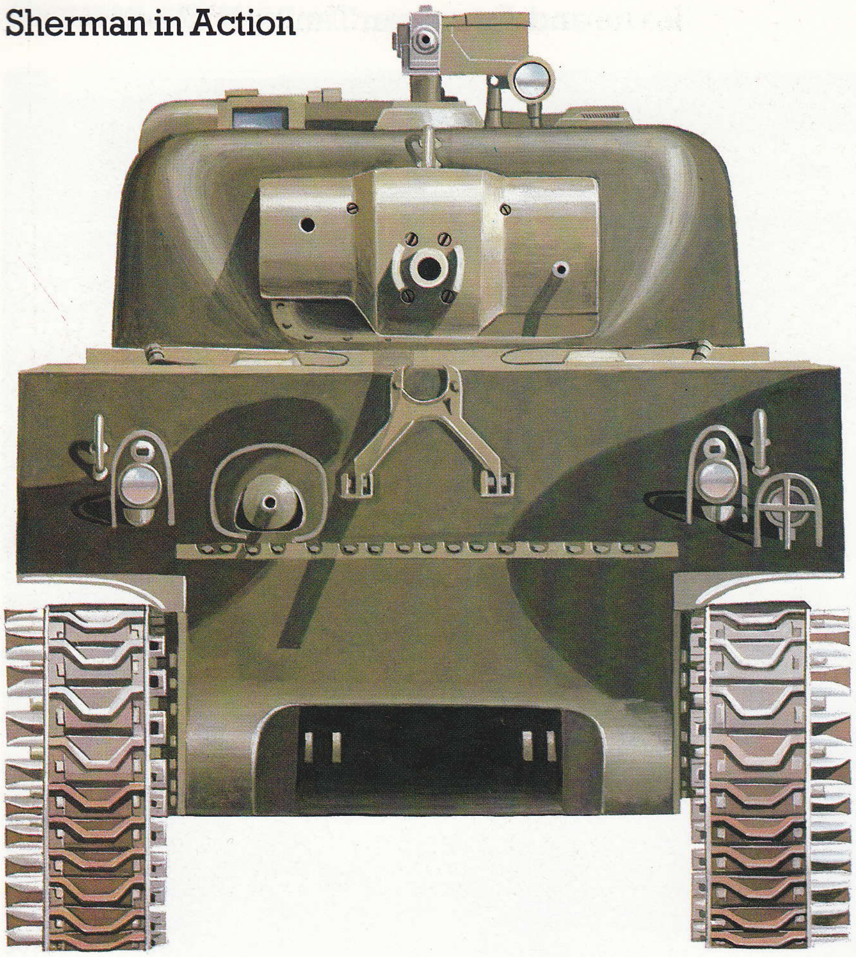
numbers of Shermans were able to 'swim' ashore from vessels moored off the Normandy beaches. They were able to do this due to the application of a British development known as 'Duplex Drive' (DD) which involved the use of folding canvas collars located around the sides of the Sherman hull. The collars served as screens (extended upwards before the Sherman reached the water) to provide buoyancy and so enable the tanks to float. As they floated they were propelled towards the beaches by propellers driven from the main tank engines. On shore the screens were collapsed and discarded, leaving the Sherman to assume its normal combat role. 'Swimming' the Sherman in this DD form was a dicey business, as the screens had very little freeboard and in rough seas, such as those prevalent on 6 June, the swimming tanks could be and indeed sometimes were swamped on the day. The DD system was much more suitable for river crossings and DD Shermans were used during the Rhine crossings of 1945. Tanks other than the Sherman used the DD system, but the Sherman was the standard British army tank for the purpose.

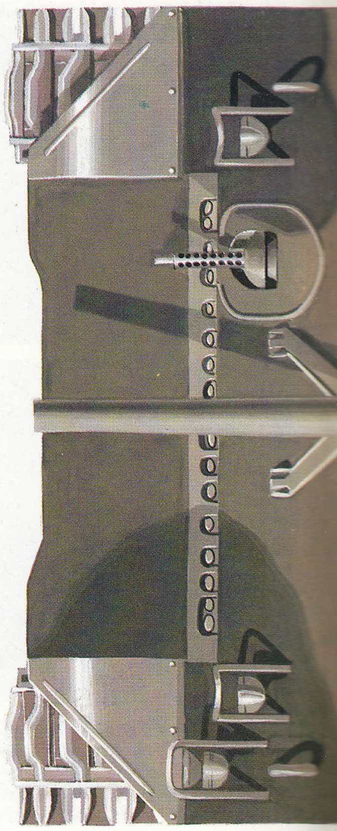
Normandy was also the scene of another British Sherman innovation for it saw the use of the Sherman 'Tulips'. The Tulips were entirely unofficial weapons, produced after tank crews had seen the power of the 'cab rank' Hawker Typhoon ground-attack fighters equipped with their airborne 76.2-mm (3-in) rockets. These rocket-equipped fighters were able to wreak havoc among the German tank units and were capable of knocking out Tigers and Panthers with comparative ease, but only if they scored a hit with their notoriously erratic missiles. The Sherman crews decided to adopt some of the rocket's weapon power for their own ends and somehow managed to 'borrow' a quantity of rockets and their launcher rails from nearby forward air bases. The launchers were welded onto the sides of the turret, and the rockets were loaded and taken into action. The results of these unofficial service trials have yet to be fully documented, but the 'Tulips' must have been formidable 'bunker-busters' and very effective against enemy tanks. Aiming must have been very troublesome given the unpredictable flight paths of the rockets. From somewhere this use of rockets on Shermans gained the name 'Tulip', but the concept's service life was not long. More formal rocket installations were later tried on US Army Shermans. Among these was the T34 'Calliope' consisting of a launching frame carrying 117-mm (4.6-in) rockets; the frame was aimed by traversing the turret and altering elevation using a linkage to the gun barrel. The 'Whiz-bang' was a similar arrangement using 183-mm (7.2-in) rockets. Neither was used to any great extent.

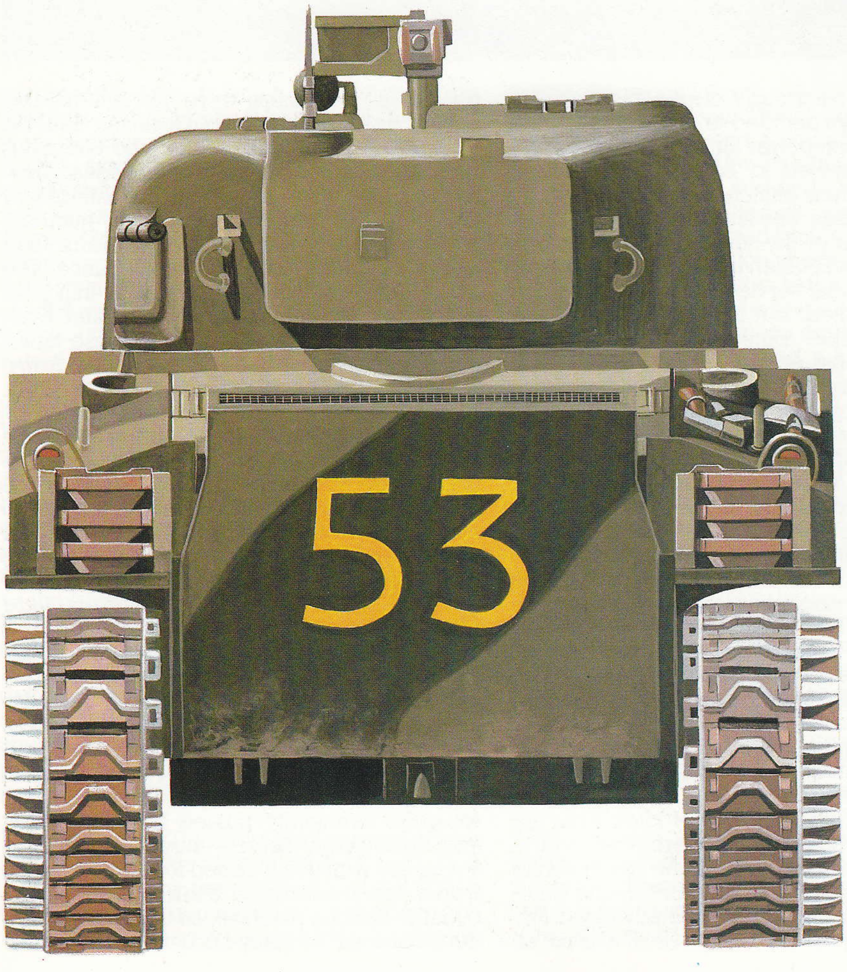
The latter days of the summer of 1944 were the World War II heydays for the Sherman. Once the slogging matches of Normandy and the Caen fighting were out of the way these tanks could range far and wide. In great sweeps covering hundreds of kilometres the Shermans of the US Army were able to advance to the very borders of the Reich, while away to the north those of the British and Commonwealth armoured divisions advanced into Belgium along the Channel coast. It was not all plain sailing, for there were frequent holding actions by the retreating Germans, but the mobility and striking power of the Shermans was amply demonstrated time and again. Tank for tank they were frequently outmatched by their German opponents, but their numbers and mobility enabled them to outflank their enemies and move back to the advance. The Shermans kept running until the only thing that seemed to stop them was the lack of fuel. Even then the 'Red Ball Express' kept these tanks, and especially those of Patton's US 3rd Army, rolling forward until they hit the Metz forts. Free French Shermans liberated Paris.

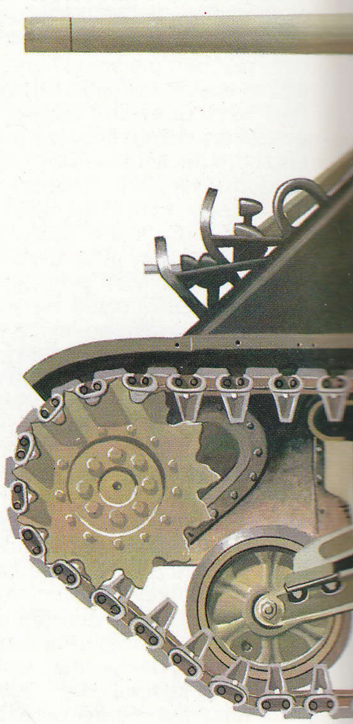
Away in the Pacific they were used almost exclusively by American forces. Japanese tanks were encountered very rarely so the Shermans usually confined their activities to the support role. For this they were equipped with 105-mm (4.13-in) howitzers in place of the main gun, and flamethrower attachments to burn the Japanese out of their bunkers were frequent fitments.

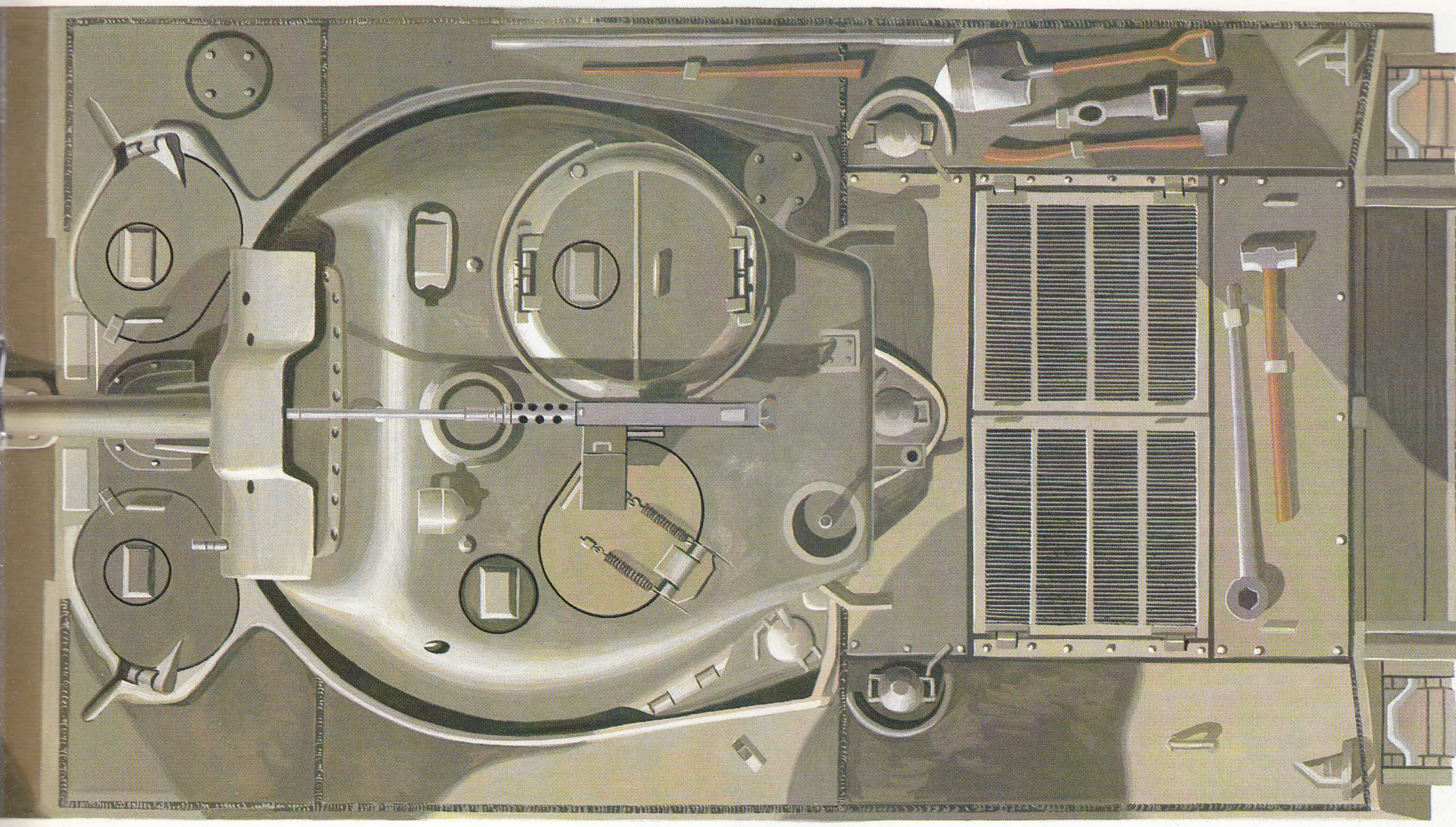
In 1945 Shermans were involved in the last advances in Europe. When they came to a final halt it was only because they ran into the T-34s of the Red Army. The Shermans had enjoyed a good run, but their work was not yet over. Ahead lay the many post-war campaigns in Korea and elsewhere, and although these weapons eventually passed from American and British army service they still remain in active use with many armed forces around the world. The 'modernized' Sherman is still a formidable fighting machine, as the Israelis have demonstrated on many occasions.

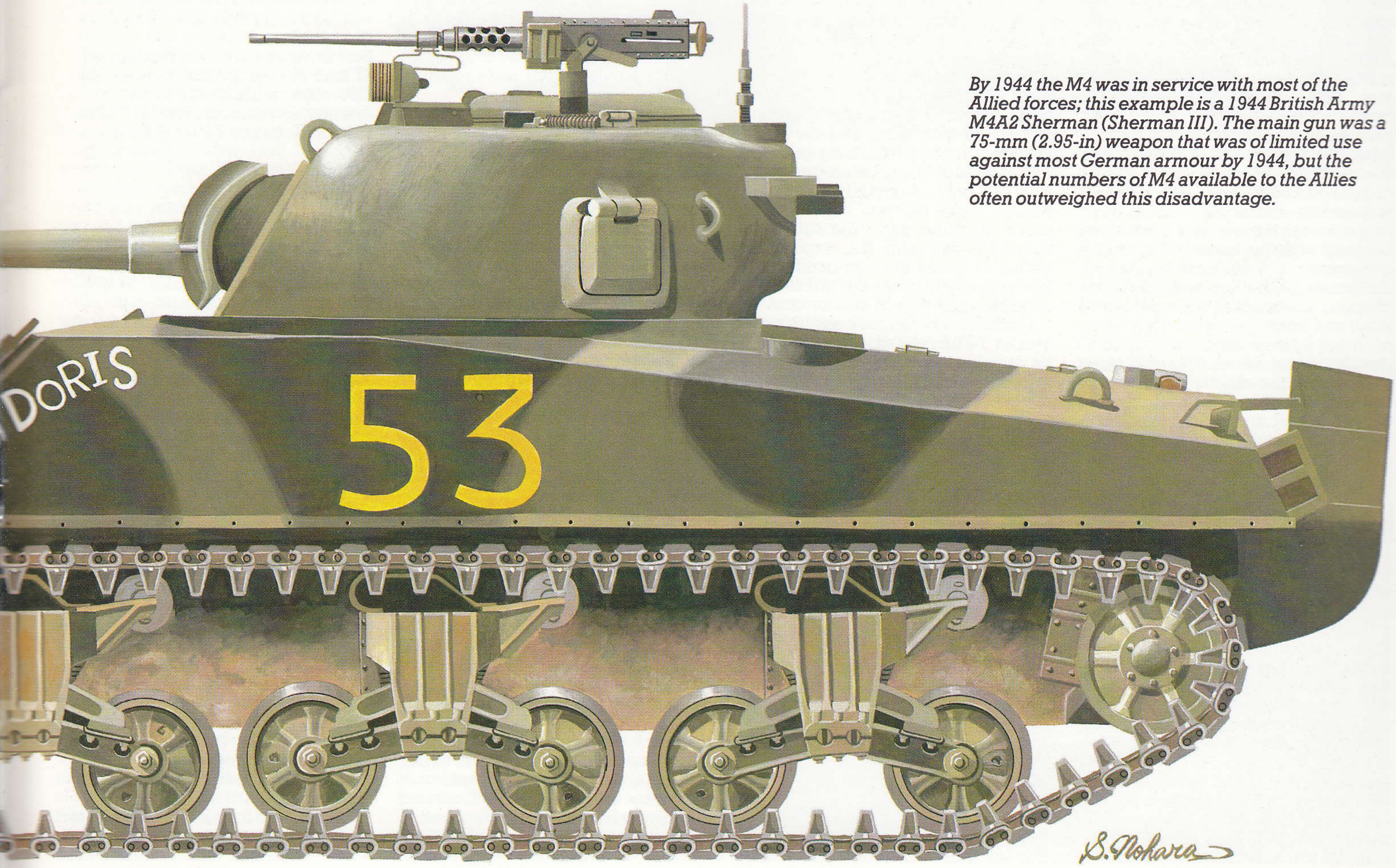





53



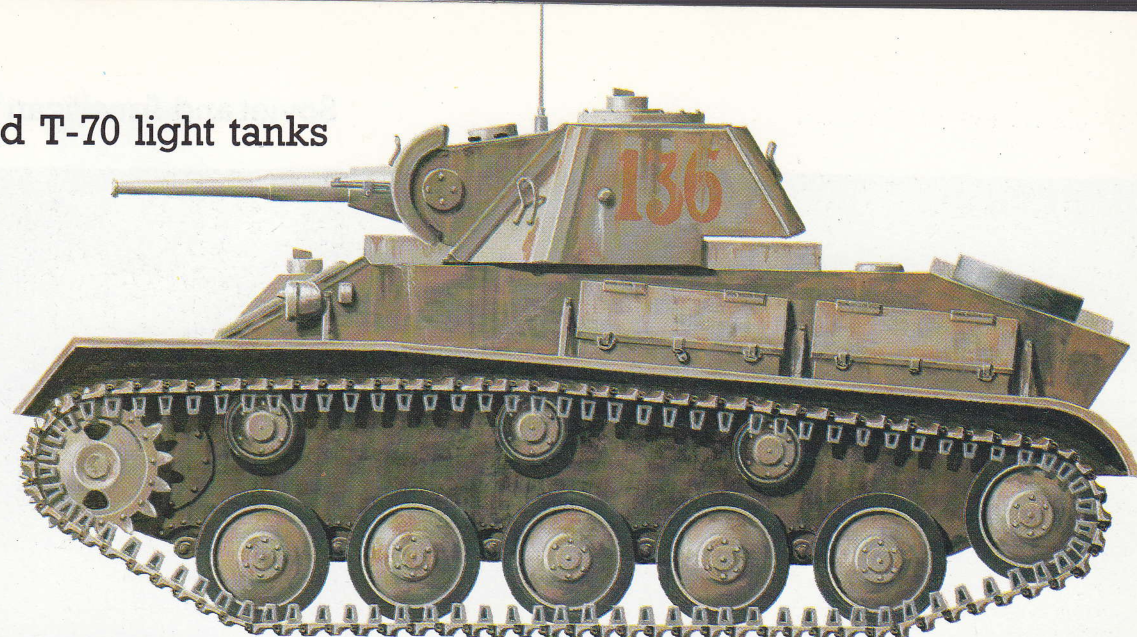




By 1944 the M4 was in service with most of the Allied forces; this example is a 1944 British Army M4A2 Sherman (Sherman III). The main gun was a 75-mm (2.95-in) weapon that was of limited use against most German armour by 1944, but the potential numbers of M4 available to the Allies often outweighed this disadvantage.

USSR

T-40, T-60 and T-70 light tanks



Above: The T-70 light tank was a useful reconnaissance vehicle, but it had only a 45-mm (1.77-in) main gun and was thus of little use in combat against heavier German tanks. In action it proved to be adequate but unexceptional.

Right: The 20-mm gun armed T-60 light tank was not a great success in action, for it was too lightly armed and armoured and lacked power and mobility. It was kept in production simply to get some sort of vehicle to the Red Army following the disasters of the 1941 campaigns.

During the 1920s and 1930s the tankette was a continuing attraction for the military mind and the tank designer, and the Soviet Union was no exception in this trend. By the late 1930s the Red Army had progressed through the stages where the one-man tankette had been tested and dropped and was in the usual stage where the tankette had developed into the two-man light tank. By the time the Germans attacked in 1940 the Red Army had invested fairly heavily in the light tank, and the models in service were the result of many years of development.

One of the main types in 1940 was the **T-40** amphibious light tank, armed with a 12.7-mm (0.5-in) machine-gun. It was the latest in a long line of models that could be traced back to the T-27 of the early 1930s. This had progressed through the T-33, the T-34 (not to be confused with the T-34 medium tank), the T-36, the T-37 and finally the T-38. Most of these lacked the amphibious capabilities of the T-40 which was placed in production in about 1940, so that by the time the invasion of 1941 started only a few (about 230) were ever completed. Many of the late-production **T-40** models (with streamlined nose and foldable trim vane) were converted into Katyusha rocket-launcher carriers and were never used as turreted tanks, whose normal armament was one 12.7-mm (0.5-in) and one 7.62-mm (0.3-in) machine-gun. Armour ranged from 6 to 13 mm (0.24 to 0.51 in) in thickness.

While the amphibious T-40 was being developed a non-amphibious version, known as the **T-40S**, was proposed. When the Germans invaded, the call was for many more tanks delivered as rapidly as possible, so the simpler T-40S was rushed into production and redesignated the **T-60** light tank. Unfortunately it was a bit of a horror in service and carried over the primary bad points of the T-40: it was too lightly armoured and, having only a 20-mm cannon plus a co-axial 7.62-mm (0.3-in) machine-gun as armament, was useless against other tanks. Also it was so underpowered that it could not keep up with the heavier T-34 tanks across country. T-60s were kept in production simply because they could be churned out quickly from relatively small and simple factories. They were powered by truck engines, many components being taken from the same source, and the slightly improved **T-60A** appeared in 1942 with slightly thicker frontal armour (35 mm/1.38 in instead of 25 mm/0.98 in) and solid instead of spoked wheels.

By late 1941 work was already under way on the T-60's successor. This was the **T-70**, whose first version used a twin-engine power train that could never have worked successfully in action and which was soon replaced by a revised arrangement. The T-70 was otherwise a considerable improvement over the T-40 and T-60. It had heavier armour (proof against 37-mm/1.46-in anti-tank guns) and the turret mounted a 45-mm (1.77-in) gun and 7.62-mm (0.3-in) machine-gun. This was still only of limited use against heavier tanks but was better than a mere machine-gun. The crew remained at two men, the commander having to act as his own gunner and loader in a fashion hardly conducive to effective operation of tank or units.

Production of the T-70 and thicker-armour **T-70A** ceased in October 1943, by which time 8,226 had been produced. In service the type proved remarkably unremarkable, and the vehicles appear to have been confined to the close support of infantry units and some limited reconnaissance tasks. By 1943 the light tank was an anachronism, but the Soviets nonetheless went ahead with a replacement known as the **T-80**. Almost as soon as it went into production its true lack of value was finally realized and the production line was switched to manufacturing components for the SU-76 self-propelled gun.

Specification
T-40
Crew: 2
Weight: 5.9 tonnes
Powerplant: one GAZ-202 petrol engine delivering 52 kW (70 hp)
Dimensions: length 4.11 m (13 ft 5.9 in); width 2.33 m (7 ft 7.7 in); height 1.95 m (6 ft 4.8 in)
Performance: maximum road speed 44 km/h (27.3 mph); road range 360 km (223.7 miles); fording amphibious; gradient 34°; vertical obstacle 0.70 m (2 ft 3.75 in); trench 1.85 m (6 ft 1 in)

Specification
T-60
Crew: 2
Weight: 6.4 tonnes
Powerplant: one GAZ-203 petrol engine delivering 63 kW (85 hp)
Dimensions: length 4.11 m (13 ft 5.9 in); width 2.3 m (7 ft 6.5 in); height 1.74 m (5 ft 8.5 in)
Performance: maximum road speed 45 km/h (28 mph); road range 450 km (280 miles); fording not known; gradient 29°; vertical obstacle 0.54 m (1 ft 9.3 in); trench 1.85 m (6 ft 1 in)

Specification
T-70
Crew: 2
Weight: 9.2 tonnes
Powerplant: two GAZ-202 petrol engines delivering a total of 104 kW (140 hp)
Dimensions: length 4.29 m (14 ft 0.9 in); width 2.32 m (7 ft 7.3 in); height 2.04 m (6 ft 8.3 in)
Performance: maximum road speed 45 km/h (28 mph); road range 360 km (223.7 miles); fording not known; gradient 34°; vertical obstacle 0.70 m (2 ft 3.6 in); trench 3.12 m (10 ft 2.8 in)

USSR

T-26 light infantry tank

During the late 1920s Red Army planners inaugurated a programme to re-equip the tank elements of the Soviet armed forces. In common with many other nations they decided upon an infantry support tank for their non-cavalry units and after attempting to develop a new design of their own decided on the mass production of a British commercial model, the 6-ton Vickers Type E light tank. This was named the **T-26** and the first examples of the British model arrived in the Soviet Union during 1930, being designated **T-26A-1**.

Soviet production of the T-26 started during 1931. The earliest models used a twin-turret arrangement mounting two machine-guns (two 7.62-mm/0.3-in weapons in the **T-26A-2**, and one 12.7-mm/0.5-in and one 7.62-mm/0.3-in gun in the **T-26A-3**), but some models had a machine-gun in one turret and a gun (27-mm in the **T.26A-4** and 37-mm **T-26A-5**); this arrangement did not survive for long and later **T-26B** models had a single turret mounting only a gun (37-mm in the **T-26B-1**, though a 45-mm gun was used later).

The early T-26 tanks were straightforward copies of the British original, and were simple, robust vehicles of mainly riveted construction. The first model was the **T-36 Model 1931** (T-26A), replaced by the **T-26 Model 1933** (T-26B) which had some design improvements. Before 1941 the Model 1933 was the most widely produced of all Soviet tanks, about 5,500 being built by the time production of that particular version ceased in 1936. A new model, the **T-26S Model 1937**, was then placed in production and this series had several changes compared with the earlier versions. The T-26S carried the 45-mm (1.77-in) main gun fitted to later versions of the Model 1933, but allied this to an improved turret design and all-welded construction as introduced on the **T-26B-2**.

The welding was introduced following operational experiences in the border clashes with Japan that took place along the Mongolian and Manchurian boundaries in 1934 and 1935. Experience showed that a T-26 which encountered hostile fire was likely to have its rivets knocked out to fly around the interior. Welding was introduced with the later Model 1933 tanks but was standard on the T-26S.

Throughout their lives the T-26 tanks underwent many production and in-service changes, most of them aimed at improving armour protection (minimum of 6 mm/0.24 in and maximum of 25 mm/0.98 in) and armament. There were also many special versions. Perhaps the most numerous of these were the flame-throwing tanks prefixed by the designation OT. Again there were several of these, the earliest being the **OT-26** and the last the **OT-133**. Most of these had the flame-throwing projector in the turret and carried no main gun, but later models did carry a gun in addition to the projector. There were also bridge-carrying versions (the **ST-26**) and attempts were made to mount 76.2-mm (3-in) guns for increased infantry fire support. The type was also developed as a command vehicle, variants being the **T-26A-4(U)** and **T-26B-2(U)**.

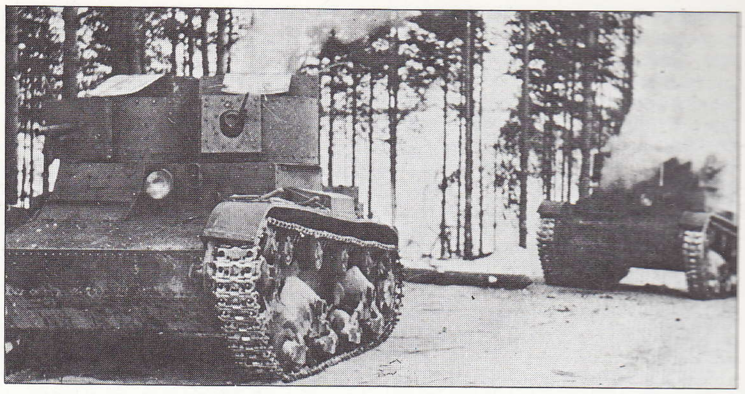
Production of the T-26 series ceased entirely in 1941 when the Germans overran most of the production facilities. New production centres set up in the Soviet hinterlands launched the production of later tank designs, but by 1941 well over 12,000 T-26 tanks of all kinds had been made. Consequently they were among the most numerous of the AFVs used during the early stages of the 'Great Patriotic War', and were also used in the 1939-1940 campaign in Finland. Some had been used during the Spanish Civil War.

After 1941 huge numbers of T-26 tanks were destroyed or passed into German hands. Many were later converted to artillery tractors or self-propelled gun carriers, usually by the Germans who always had a need for such vehicles.

Overall the T-26 was an unremarkable little tank that was unable to stand up to the demands of 1941, but it enabled the Soviet Union to establish its own mass production facilities and know-how, and these stood them in good stead after 1941.

Specification

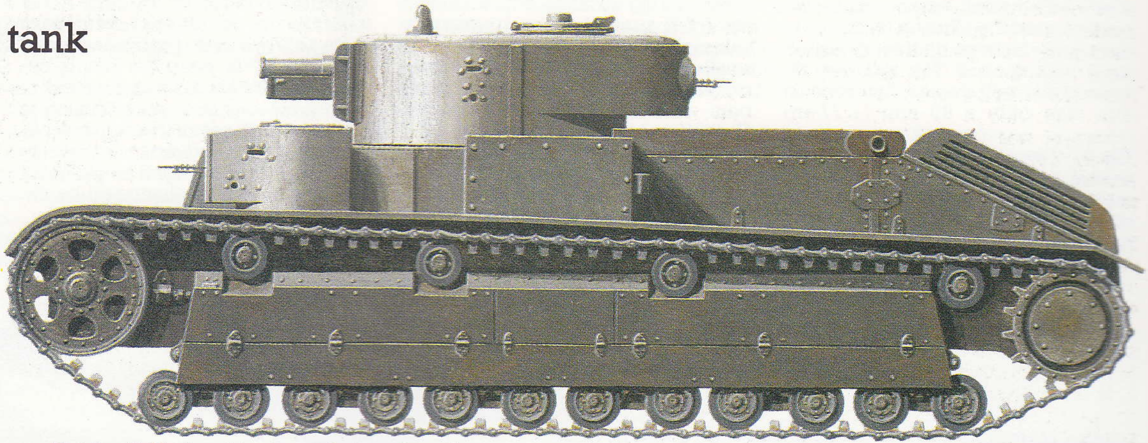
T-26B
Crew: 3
Weight: 9.4 tonnes
Powerplant: one GAZ T-26 8-cylinder petrol engine developing 68 kW (91 hp)
Dimensions: length 4.88 m (16 ft); width 3.41 m (11 ft 2.25 in); height 2.41 m (7 ft 11 in)
Performance: maximum road speed 28 km/h (17.4 mph); maximum road range 175 km (108.7 miles); fording not known; gradient 40°; vertical obstacle 0.79 m (2 ft 7 in); trench 1.90 m (6 ft 2.8 in)



One of the many variants of the T-26 light infantry tank was the Model 1931, which had dual turrets, usually mounting two 7.62-mm (0.30-in) machine-guns, but sometimes having one of the machine-guns replaced by a 37-mm (1.46-in) short infantry support gun. The later T-26 Model 1933 had a single turret.

USSR

T-28 medium tank



The Soviet T-28 heavy tank weighed 28 tons but was termed a medium tank. It had a crew of six and had a short 76.2-mm (3-in) gun as its main armament, plus machine-guns in the two extra turrets mounted in front of the main turret. They were clumsy vehicles with armour that proved to be too thin once in action.

The Soviet **T-28** medium tank was an indigenous design that entered production in Leningrad during 1933. It was greatly influenced by current trends shown in German and British (Vickers) experimental designs, and so featured the fashionable multi-turret layout. The T-28 had three, the main gun turret being partially flanked by two smaller ones armed with machine-guns, the driver's position being between the two auxiliary turrets.

The prototype T-28 had a 45-mm (1.77-in) main gun, but on T-28 and **T-28A** production models (the latter with thicker front armour) this was changed to a short 76.2-mm (3-in) gun, **T28B** production models after 1938 having a newer and longer 76.2-mm (3-in) gun with improved performance. The secondary armament was three 7.62-mm (0.3-in) machine-guns. Overall the T-28 was a large and slab-sided brute but the Soviet tank design teams were still in the process of learning their trade, and experience with the T-28 was later of great importance.

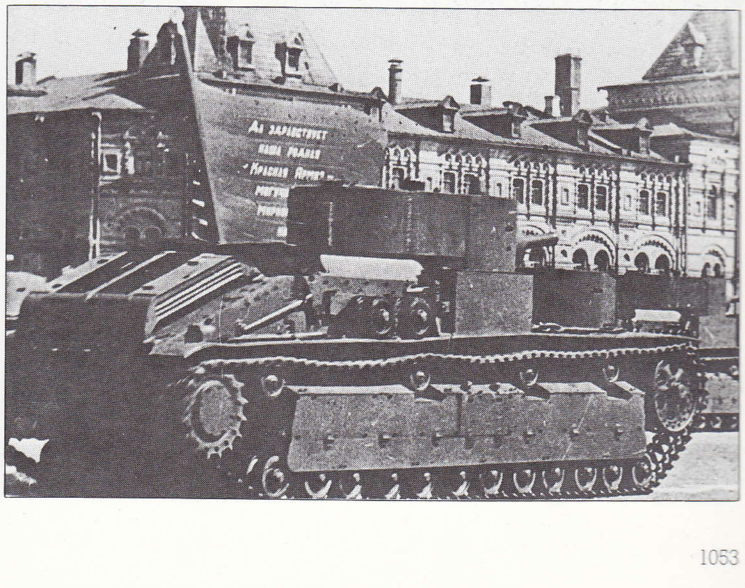
Construction of the original production model, the **T-28 Model 1934**, lasted until 1938 when the improved T-28B appeared with the new gun (see above), rudimentary gun stabilization and some engine modifications. This was the **T-28 Model 1938**, and manufacture of this version lasted until 1940, when production ceased in favour of later models. The armour of the different versions ranged from a minimum of 20 mm (0.79 in) to a maximum of 80 mm (3.15 in) in thickness.

There were several experimental versions of the T-28 including some self-propelled guns and specials such as bridging and assault engineering tanks. None of these experimentals got past the prototype stage, but experience with them was of great importance when later variations on production tanks were contemplated. In fact the T-28 was of more value as an educational tank than as a combat tank. Its service life was short, spanning only the years from 1939 to 1941. In 1939 it was used in action against the Finns during the 'Winter War'. In that short conflict the T-28s fared badly as their crews found out the hard way that the vehicle's armour was too thin for safety and those tanks that survived underwent a hasty course of modifications to add extra armour (up to 80 mm/3.15 in). The modified T-28s were known as the **T-28E** (*ekanirovki*, or screened, i.e. uparmoured), but the crash programme proved to have been of doubtful effectiveness when the Germans invaded the Soviet Union in 1941. The T-28E was also known as the **T-28M** or **T-28 Model 1940**.

In 1941 the surviving T-28s demonstrated themselves to be of only limited combat value. Their large slab sides and stately performance made them easy prey for German anti-tank weapons. They also proved vulnerable to mines, and during the 'Winter War' of 1939-1940 some T-28s were modified to carry anti-mine rollers in front of the vehicle. These rollers were not a success, but again the experience gained with them proved to be of great value later. Thus the T-28 passed from the scene, proving itself to belong to an earlier era of tank design.

Specification

T-28
Crew: 6
Weight: 28 tonnes
Powerplant: one M-17 V-12 petrol engine developing 373 kW (500 hp)
Dimensions: length 7.44 m (24 ft 4.8 in); width 2.81 m (9 ft 2.75 in); height 2.82 m (9 ft 3 in)
Performance: maximum road speed 37 km/h (23 mph); maximum road range 220 km (136.7 miles); fording not known; gradient 43°; vertical obstacle 1.04 m (3 ft 5 in); trench 2.90 m (9 ft 6 in)



The T-28 medium tank was one of the least successful pre-war Soviet tank designs for in action in 1940 and 1941 it proved to be cumbersome, inadequately armoured and undergunned. The main gun was a short 76.2-mm (3-in) weapon that was replaced in some cases by a longer-barrelled gun of the same calibre.

USSR

BT-7 fast tank

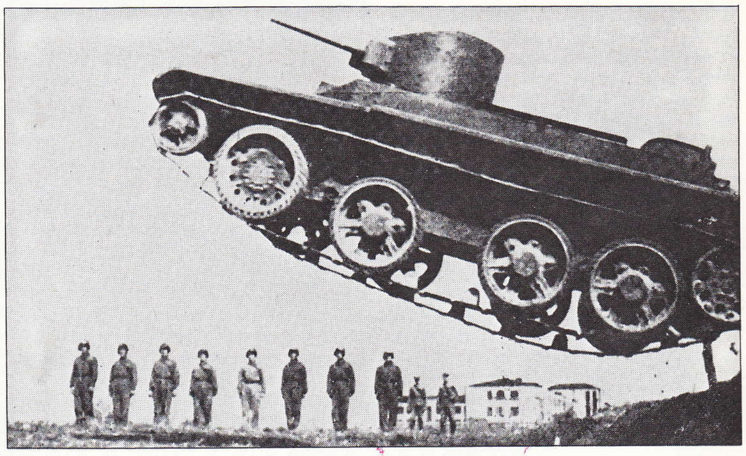
When the Red Army tank staff decided to modernize its tank fleet during the late 1920s it authorized the design bureaux to use whatever sources they liked to obtain the best ideas available. Accordingly many promising design concepts from all over the world were embraced, and among these were ideas of the American J. Walter Christie. His advanced suspension designs had little effect in his own country at that time, but the Soviets embraced his concepts willingly and took them over for their own further development. The Christie suspension was integrated into the BT series (*bystrochodya tank*, or fast tank).

The first Soviet BTs were copied exactly from a Christie prototype delivered to the Soviet union in 1930 and designated **BT-1**. The first Soviet model was the **BT-2**, and from 1931 onwards the BT series progressed through a series of design developments and improvements until the **BT-7** was produced in 1935. Like the earlier BT tanks the BT-7 was a fast and agile vehicle intended for Red Army cavalry units, and was powered by a converted aircraft engine. The suspension used the Christie torsion bars that allowed a large degree of flexibility at high speeds. The hull was all-welded and well shaped, but the main gun was only a 45-mm (1.77-in) weapon, although this was still larger than that fitted on many contemporary equivalents. The secondary armament was two 7.62-mm (0.3-in) machine-guns, and armour varied from 10 to 22 mm (0.39 to 0.87 in).

The BT-7 proved to be very popular with its users. By the tme it entered service (in its original **BT-7-1** form with a cylindrical turret, replaced by a conical turret in the **BT-7-2**) many of the automotive snags that had troubled some of the earlier BTs had been eliminated, and the BT-7 thus proved to be fairly reliable. Also, by the time it appeared there were many variants of the BTs: some were produced as flamethrower tanks, and there was a special **BT-7A** close-support version carrying a short 76.2-mm (3-in) main gun. Other experimentals included amphibious and bridging tanks, and variants with various tracks to improve terrain-crossing capabilities.

The BT-7 did have one major tactical disadvantage in that it was only lightly armoured. On the entire BT series armour protection had been sacrificed for speed and mobility, and once in action during 1939 the BTs, including the BT-7, proved to be surprisingly vulnerable to anti-tank weapons as small as anti-tank rifles. BT-5s had demonstrated this fact when small numbers were used during the Spanish Civil War, but even though the BT-7 had some armour increases this was still not enough, as revealed in Finland during 1939 and 1940. As a result the design of a successor to the BT series was undertaken and this led ultimately to the adoption of the T-34. Variants of the BT-7 were the **BT-7-1(U)** command tank and **BT-7M** (or **BT-8**) improved model with full-width and well-sloped glacis plate plus a V-2 diesel engine.

Thus the BT-7 played its major part in World War II well before the Germans invaded the Soviet Union in 1941. Large numbers were still in service in 1941, but they fared badly against the advancing Panzers. Despite their mobility the Soviet tank formations were poorly handled and many tanks, including BT-7s, were lost simply because they broke down as the result of poor maintenance or poor training of their crews. It was an inauspicious beginning for the Red Army, but worse was soon to follow and the large fleet of BT-7s was virtually eliminated by the end of 1941.



The BT-2 was the first Soviet tank design to incorporate the Christie suspension, and led to a whole string of BT variants that were eventually developed into the T-34 series. The Christie suspension gave the BT-2 a good cross-country performance, as this photograph graphically demonstrates.

Specification

BT-7

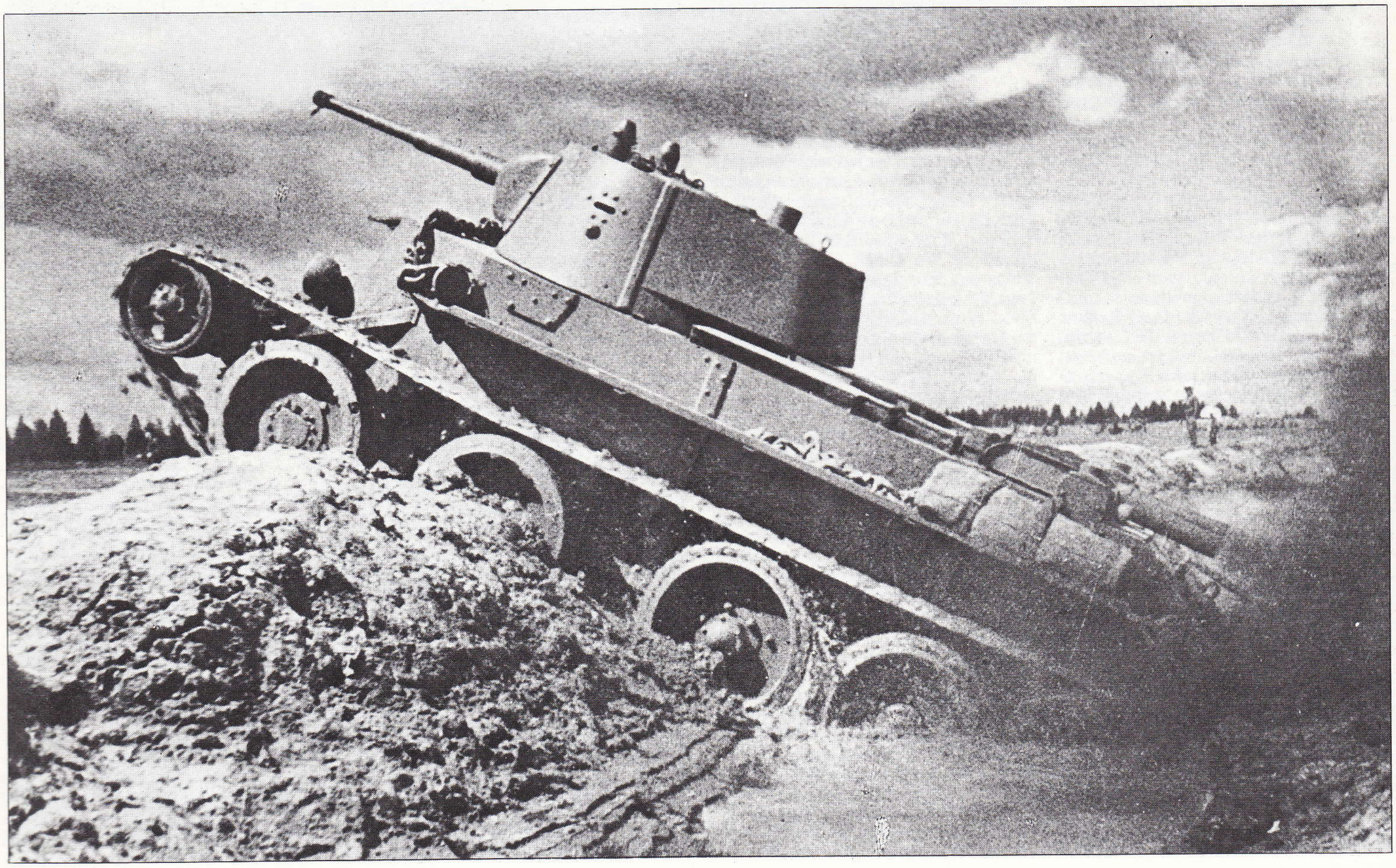
Crew: 3

Weight: 14 tonnes

Powerplant: one M-17T V-12 petrol engine developing 373 kW (500 hp)

Dimensions: length 5.66 m (18 ft 6.8 in); width 2.29 m (7 ft 6 in); height 2.42 m (7 ft 11.3 in)

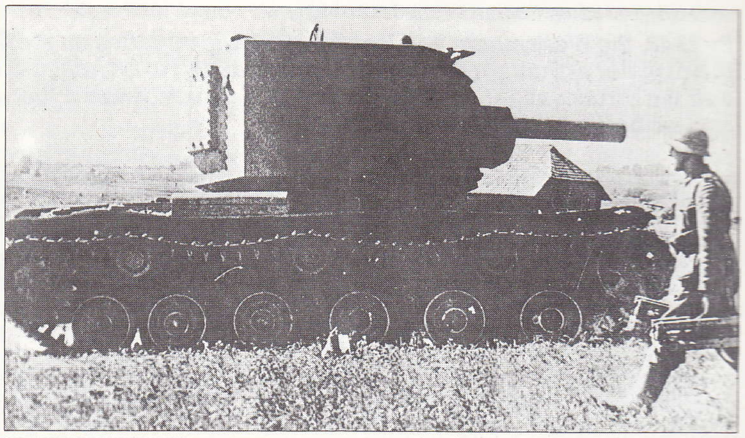
Performance: maximum road speed 86 km/h (53.4 mph); maximum road range 250 km (155 miles); fording 1.22 m (4 ft); gradient 32°; vertical obstacle 0.76 m (2 ft 6 in); trench 1.83 m (6 ft)



The BT-7 was introduced into service in 1935 and was produced in two main versions, both armed with a 45-mm (1.77-in) gun. Although fast and handy in action, the BT-7 proved to be too lightly armoured, but it led in time to the development of the T-34 series.

Soviet Tank Development

One of the revelations of World War II was the quality of Soviet tank design. From the superb T-34, which gave the seemingly invincible Wehrmacht such a shock, to the immensely potent IS-2 leading the drive by Zhukov and Koniev on Berlin, the Red Army tank proved a match for the best the Germans could offer.



In an attempt to provide their tank forces with artillery fire support, the Red Army introduced the KV-2, a KV chassis with a 152-mm howitzer mounted in a massive open topped turret. The KV-2 was not a great success.

In the years immediately after World War I the Soviet Union was in a post-revolutionary state that allowed little time or facilities for matters such as the finer points of tank development. For the immediate future the Soviets were content to rely upon what they had already, and the only armour development that took place was concerned mainly with armoured cars and some investigation of light tanks. By the late 1920s this had changed. It was proposed that the Red Army should become largely mechanized, but at that time Soviet heavy industry was in no state to undertake such a massive programme and would have to be rebuilt from the ravages of the post-revolution era.

The Soviets had no reservoir of tank design expertise upon which to draw, so they took the simplest way out and purchased the knowhow. One immediate result was the joint Soviet-German tank testing facility at Kazan which was secretly established during the late 1920s within the Soviet Union. Soviet automotive engineers were thus able to observe German thinking on tank design, but they soon learned that the Germans had almost as much to learn as they had themselves. Consequently the designers looked abroad, obtaining what they wanted by industrial espionage or by the simple expedient of purchasing licence production rights. In this way they obtained examples of the Vickers Carden-Loyd tankettes that started a development line leading up to the T-70 light tank, and of the Christie prototypes that were later developed into the BT series that led to the T-34. The Vickers 6-ton light tank was purchased and copied to form the basis for the T-26 light tanks. The multi-turret concept was slavishly copied from current British and German practice, but that line soon showed itself to be a blind alley of tank design.

Using these 'take-away' models as a basis the Soviet tank design bureaux had the beginnings of an industry. One odd aspect of this purchasing of knowhow was that none of the designs obtained were ever given much backing in their countries of origin. The Vickers 6-ton tank was not accepted by the United Kingdom or Christie's futuristic designs by the United States, but by taking the best points from their imported models the Soviet designers gradually developed what suited their requirements.

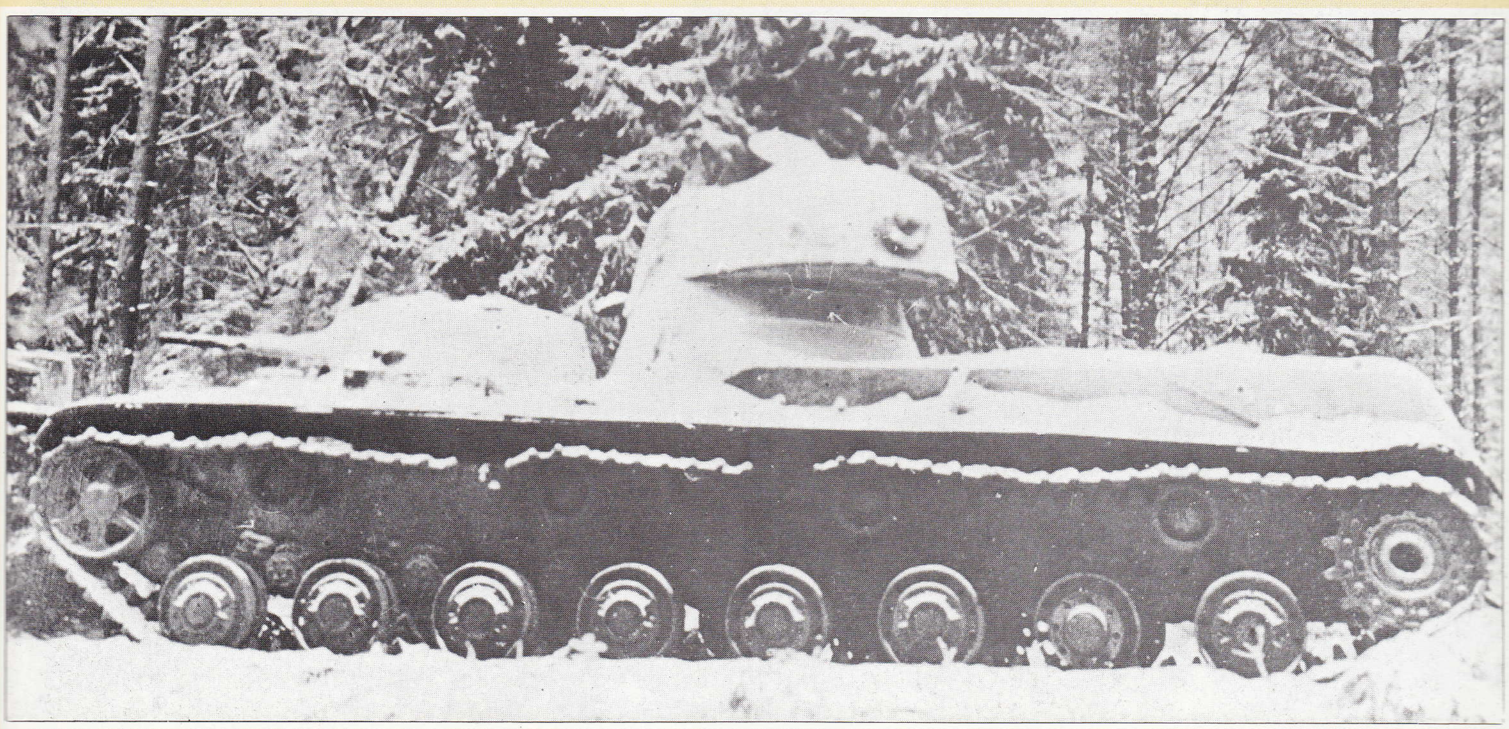
The Christie original best illustrates this point. The suspension that formed the main attraction of the Christie models was taken over virtually unchanged, but was considerably strengthened. Upon this high-speed suspension the upper hull was provided with the thickest armour possible, and a heavier gun than in most contemporary equivalents was installed. The result was the BT series, and although these turned out to be too lightly armoured after 1940 the Soviet designers had started a trend they were to repeat in the future. By a process of gradual development that took the best points from each model, the BT series evolved into the T-34, the medium tank that proved to be the war-winner for the Red Army. But even with the T-34 the process of gradual development and improvement continued to the point where no major innovations were ever made. The armour gradually got thicker, automotive improvements were installed only piecemeal, and the tank was upgunned by the simple expedient of taking the turret and gun from a KV-85 and placing them onto a T-34 hull. It was this gradual process of innovation that allowed the Soviet Union to build up such remarkable production totals, for during the initial stages of the nation's 'Great Patriotic War' it was quantity that mattered above all else.

A similar development programme was followed with the KV series that later evolved into the IS series, but on occasion some drastic innovations were attempted. In order to develop some form of qualitative advance, several design bureaux were constantly maintained. From time to time these were allowed to produce novel designs which sometimes got built, but few of them ever reached the production stage. Instead, the designs' better points were introduced to existing models.

Large numbers of armoured vehicles reached the Soviet Union via Lend-Lease, but although Soviet designers examined all of them they found little worthwhile to copy. By their estimates the Allied designs lacked firepower, armour and engine power, but they were happy enough to use them at a time when their own strengths were low. One feature that they always commented upon was that the American and British production standards were too high. By contrast the finish of Soviet tanks was nearly always rough, but quite adequate for the tasks in hand.

By 1945 Soviet tank designs were second to none, and this had been brought about by gradual development and the ability of the Soviet designers to grasp exactly what the Red Army needed. Mass production was always a priority and these weapons were designed accordingly, the result being the biggest tank fleet of any of the Allied powers.

The T-100, seen here, and the essentially similar SMK heavy tanks were intended to be the successor designs to replace the T-35, but combat experience gained in Finland demonstrated the drawbacks of the twin-turret arrangement and led to the development of the much more effective KV series.



The Battle of Kursk

By 1943, the Wehrmacht had lost the strategic initiative on the Eastern Front. After the disaster at Stalingrad, a crushing defeat had to be inflicted upon the Red Army, and the Kursk Salient seemed the obvious choice. It was 5 July, and the greatest land and air battle in history was under way.

War has been likened to an exchange of energy: nations clash and expend their latent energies at one another in the form of firepower and projectiles until one side or the other gains an ascendancy, the nation with the greatest latent energy normally emerging the victor. This analogy was certainly true in World War II when the Red Army and the power of the Soviet Union met head-on with the power of the German armed forces and the might of the German nation. But the problem for the Red Army was that in 1941 its available power had been severely crushed by the rapid advances of the Germans. Thereafter it needed time to gather its energies for the inevitable counterstroke that would push the invaders from 'Mother Russia'.

There was never any doubt in the Soviet leaders' minds that the invader would have to be forcibly evicted. Even in the desperate days of late 1941, when the Germans were at the gates of Moscow, there were always the vast expanses of the Soviet Union into which the huge bulk of the Soviet population could move to work for the counteroffensive. The first of these strategic counterblows had taken place in late 1942 and early 1943, when the Battle of Stalingrad had finally gone the way of the Red Army with the loss to the Germans of an entire army.

Early 1943 was a time of regrouping on both sides. Both armies reorganized and re-equipped, but there was also a change from previous years. The Germans had for the first time in the war lost the strategic initiative. Although they did not realize it, they were by then expending their national energy and assets at the very time when the Soviets were building up their energy and assets. Assisted in some measure by deliveries of military matériel by the Western Allies, the Red Army was by early 1943 in a position to field fresh divisions on a scale never before contemplated. Even after the massive battles of 1942 Soviet industry was able to deliver all manner of new equipment for the fighting troops, much of it of an advanced kind and the equal of anything the Germans could produce. The Soviets were only just getting into their production stride. The dreadful upheavals of 1941 were long in the past, and the losses of 1941 and 1942 had been more than made good. By mid-1943 the Red Army could field 9,500 armoured vehicles of all kinds, many of them redoubtable T-34s.

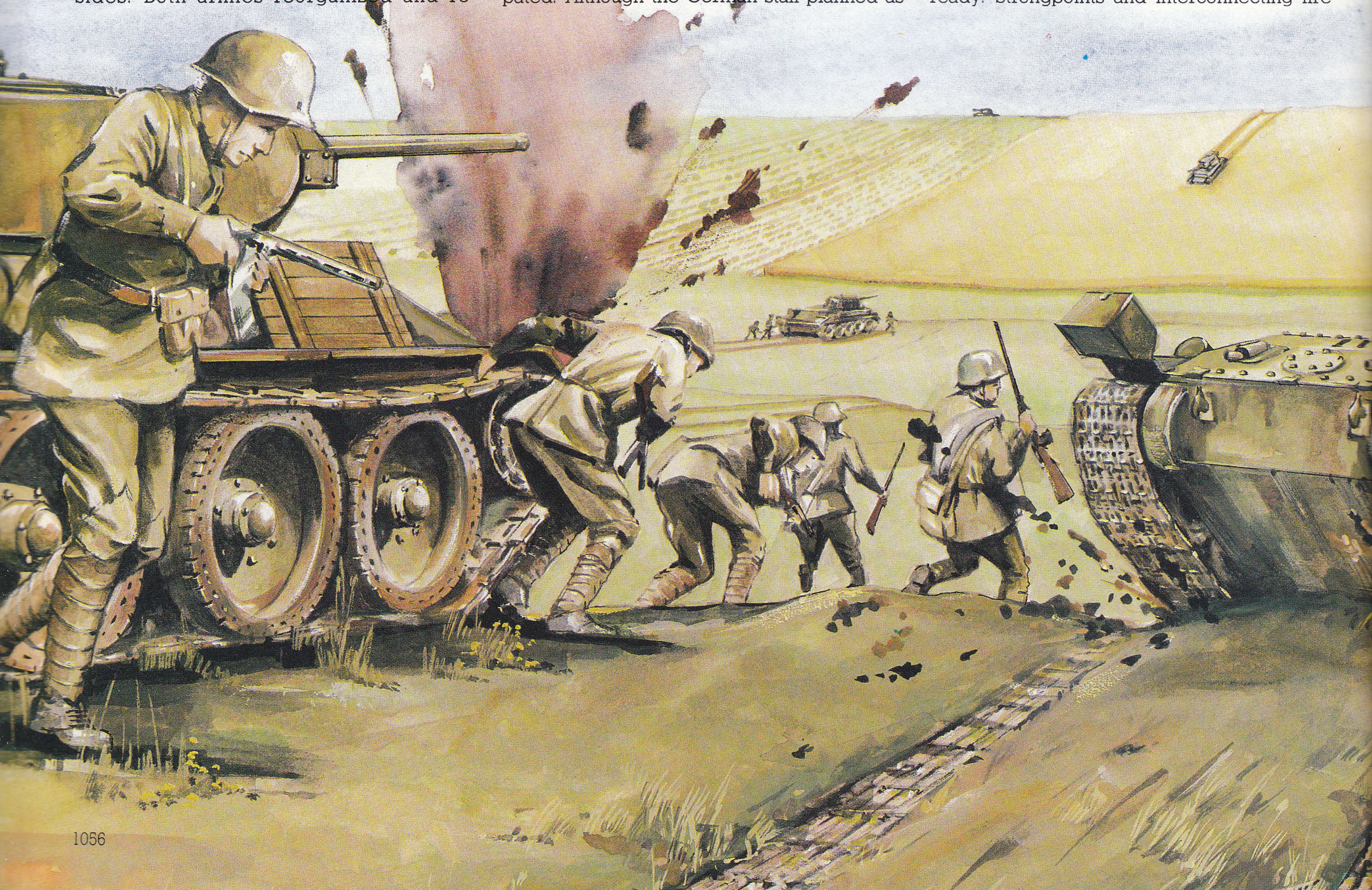
Kursk Salient

There was no doubt where the next German blow would fall. The fighting of the previous year had left an outward bulge (salient) in the Red Army lines around Kursk and this was to be the next German objective. Again, in 1943 there was to be a change from previous years in that this time the German blow was anticipated. Although the German staff planned as meticulously as ever it could not disguise the forthcoming operation, so the Red Army was ideally placed to plan its response.

The Soviets planned for the forthcoming blow by moving nearly three-quarters of their available armour resources into the Kursk salient. Together with the armour went nearly all their artillery and numerous infantry divisions. Much of this investment went not into a forward disposition but into a powerful reserve in the rear ready for a counteroffensive, as the Red Army was already thinking of a huge advance westwards. In the front lines of the Kursk salient whole Soviet armies were deployed, and opposing them were almost equally powerful forces.

The German attackers were disposed in two large army groups. To the north of the salient was Army Group 'Centre' based on Model's 9th Army with no less than three Panzer corps. To the south was Army Group 'South' based on Hoth's 4th Panzer Army with some of the finest of the available Panzer divisions. In all some 17 Panzer divisions stood ready to fall on the Red Army around Kursk. They were equipped with the latest Tiger and Panther tanks, and in fact the operation was actually delayed until the Panthers were ready, for much was expected of them. They would also be joined by the new Elefant assault gun with its 88-mm (3.46-in) armament.

The Red Army prepared very thoroughly for the assault. No less than 20,000 guns of all kinds were massed ready for the German attack, and at the front huge defensive lines equipped with anti-tank weapons of all kinds stood ready. The defensive belts were tens of kilometres deep, with adequate reserves of all forms at the ready. Strongpoints and interconnecting fire



plans abounded, and huge minefields were laid.

The attack is launched

The Red Army had one advantage the Germans lacked. Deep in the German rear partisan bands constantly watched German activities and reported back to Red Army headquarters. Any move the Germans made was relayed back and countermoves were arranged accordingly. Thus it was that as the German forces massed for the attack during the early hours of 5 July 1943 a storm of Soviet artillery fell among them to disrupt and disorganize at a critical moment. The attack had to be postponed for 90 minutes, but eventually it went in to be met by a veritable hail of fire.

For once attackers and defenders were evenly matched. In numerical terms there was little to chose between the two, but the Germans did have a qualitative advantage with their new tanks; however, this was more theoretical than practical, for the tanks ran directly into a wall of anti-tank fire that stopped them dead in their tracks. Red Army tank-killer squads then ran all over them and destroyed them by placing explosive charges in their exhausts or by their fuel tanks. The Elefant assault guns fared particularly badly (nearly all were lost) as they had no defensive machine-guns, and at such close ranges were virtually sitting ducks for the attentions of the tank-killing squads. The Tigers and Panthers managed little better. Many of the underdeveloped Panthers either broke down or proved to have serious 'bugs' in their systems, and were thus rather less than effective. As ever, the Tigers survived well but could make little headway against the massed anti-tank guns. By the end of the day the defences of the salient were almost everywhere intact.

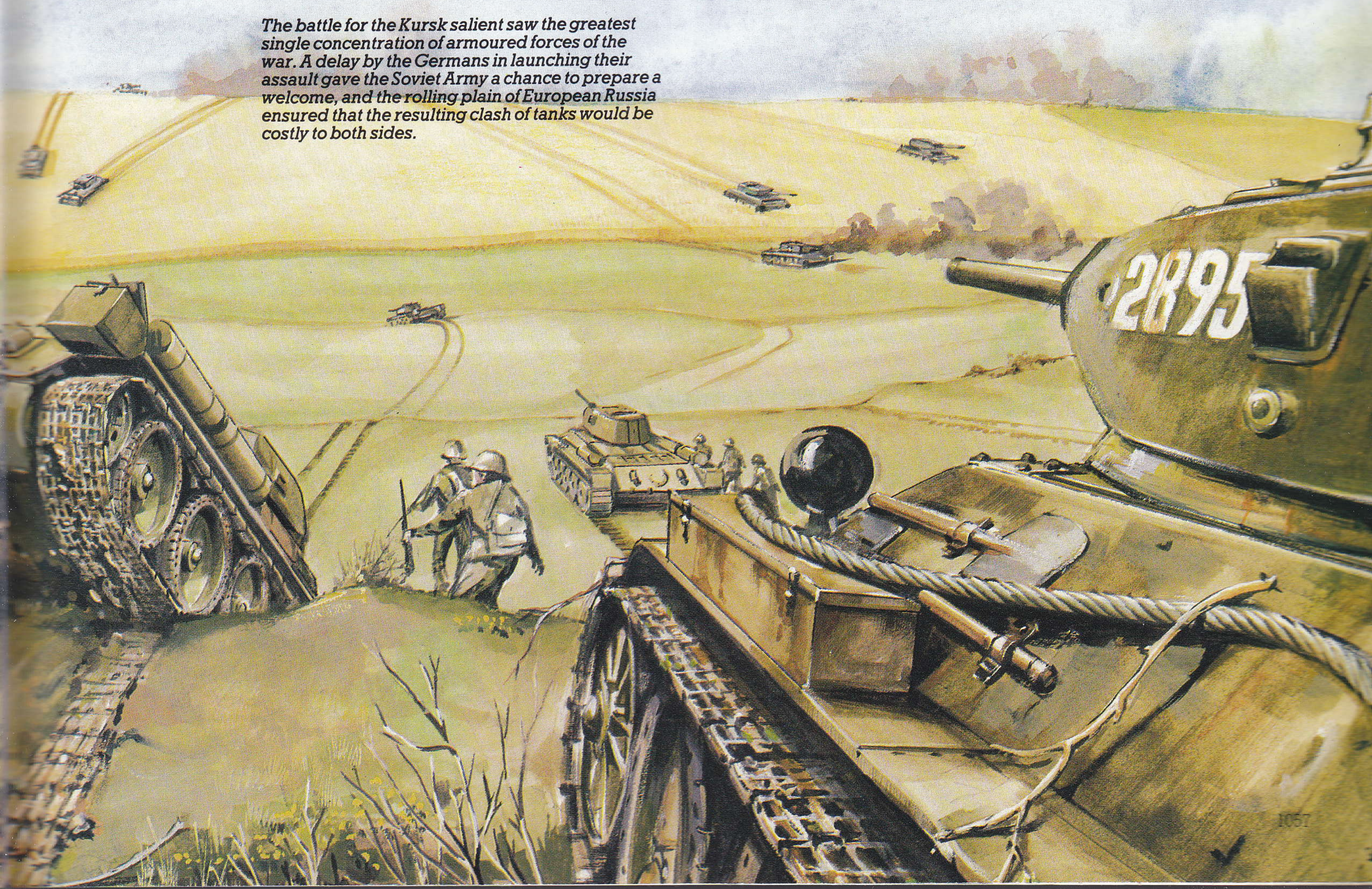
The Red Army had managed to contain the German advance, but appreciated that the attack would soon be renewed. On the following day the Panzers moved forward again, this time with supporting screens of infantry, and in the days that followed the Germans gradually moved forward on the flanks with their tanks always in support. The Soviets lost heavily, but checked and constantly slowed the advancing Germans, who were not able to reach their objectives.

Armoured armies toe-to-toe

By 12 July the time was right for the counterstroke. It started on the southern flank of the salient when the remaining forces of the 4th Panzer Army massed for another advance. As they moved forward they ran straight into the massed armour of the Soviet 5th Guards Tank Army. It was the greatest tank battle in history as well over 1,500 tanks met head-on in a mighty clash of armour. A huge dust cloud developed in which the tanks of both sides milled and jostled, but this time it was the turn of the Red Army to come out on top. Their tanks and crews were fresh and had not had to endure over a week of hard combat before they reached the battle, as had been the case for the Germans. Also their T-34s were backed up by new armoured vehicles like the Su-85 self-propelled gun, in action for the first time with an 85-mm (3.34-in) high-velocity gun mounted in an armoured superstructure on a T-34 hull and used as a very effective tank-killer. Another Red Army surprise was the first appearance of the SU-152 Zvierboy (animal hunter), a KV chassis mounting a 152-mm (6-in) howitzer that was able to shatter German tanks by shell power alone.

By the evening of 12 July the Soviets were in possession of the battlefield as the Germans fell back to the rear to avoid annihilation. The 4th Panzer Army had been virtually destroyed and what was intended to be yet another breakthrough had turned into yet another major German defeat. It was time for the counterattack, and it duly followed the German withdrawal. Under a huge barrage by over 3,000 artillery pieces the Red Army fell upon the Germans on both flanks of the Kursk salient. Within days it had ceased to exist as the walls of the salient were pushed outward. The battle ranged not only on the ground but in the air as well. The Soviet air forces were able to gain a mastery of the air which they used to full effect. As the Germans fell back they were constantly harassed by hordes of Ilyushin Il-2 and other strike aircraft.

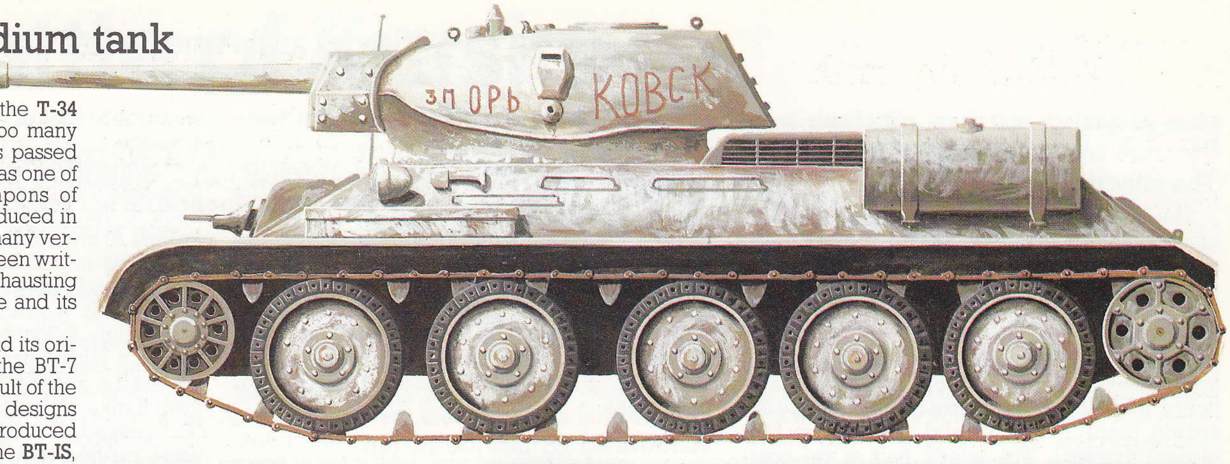
The Kursk fighting did not finally die down until late August, but by that time the Germans had been pushed rearward far beyond their original start points. Their long retreat back to Germany had finally begun, and although they were later to regroup and regain local initiatives, their ultimate defeat was already well under way. The Germans were not beaten at Kursk by the Soviet armed forces alone. They were also beaten by the latent energy of the ordinary Soviet people who worked long shifts under desperate conditions for many months in order to arm, clothe and feed the front-line Red army soldiers, and without them the Soviet armed forces would have been powerless. They provided the energy that finally overcame the power of the German nation.



The battle for the Kursk salient saw the greatest single concentration of armoured forces of the war. A delay by the Germans in launching their assault gave the Soviet Army a chance to prepare a welcome, and the rolling plain of European Russia ensured that the resulting clash of tanks would be costly to both sides.

USSR

T-34 medium tank



Above: The T-34 tank was a very advanced design for its time. This is a late production T-34/76 armed with a 76.2-mm (3-in) main gun, and well provided with sloping armour for added protection. The tank was produced in thousands and proved durable, mobile and highly effective in service.

It is now difficult to write of the **T-34** medium tank without using too many superlatives, for the T-34 has passed into the realms of legend. It was one of the main war-winning weapons of World War II, and it was produced in such vast numbers and in so many versions that entire books have been written on the subject without exhausting the possibilities of the vehicle and its exploits.

In simple terms the T-34 had its origins in the shortcomings of the BT-7 and its forebears. The first result of the BT series' up-dating were the designs known as the **A-20** and **A-30**, produced in 1938 as developments of the **BT-IS**, but passed over in favour of a heavier-gunned tank with increased armour and known as the **T-32**. In the T-32 can be seen most of the features of the later T-34. It had a well-shaped hull with sloped armour, and a cast and sloped turret which mounted a 76.2-mm (3-in) high-velocity gun. The Christie suspension, suitably beefed up, was carried over from the BT series, but the ability to run on wheels without tracks was abandoned.

Good as the T-32 was, a selection panel requested yet more armour and so the T-34 was born. It went into production in 1940 and mass production of the **T-34/76A** soon followed. When the Germans attacked the Soviet Union in 1941 the type was already well established, and its apperance came as a nasty shock to the Germans. The T-34's well-sloped and thick armour (minimum of 18 mm/0.71 in and maximum of 60 mm/2.36 in) was proof against most of their anti-tank weapons and the L/30 76.2-mm (3-in) gun, soon replaced in service by an even more powerful L/40 gun of the same calibre, was effective against most German Panzers. The secondary armament was two 7.62-mm (0.3-in) machine-guns.

From 1941 onwards the T-34 was developed into a long string of models, many of them with few external differences. Production demands resulted in many expediences, the finish of most T-34s being rough to an extreme, but the vehicles were still very effective fighting machines. Despite the disruption of the production lines during 1941, ever-increasing numbers poured off the extemporized lines, and all manner of time-saving production methods (ranging from automatic welding to leaving whole sections of surface unpainted) were used. The second production model was the **T-34/76B** with a rolled-plate turret.

In service the T-34 was used for every role, ranging from main battle tank to reconnaissance vehicle, and from engineering tank to recovery vehicle. It was converted into the simplest of armoured personnel carriers by simply carrying infantry on the hull over long distances; these 'tank descent' troops became the scourge of the Germans as they advanced westwards through the liberated Soviet Union and then Eastern Europe. Successively improved models of the T-34/76 were the **T-34/76C** with a larger turret containing twin roof hatches in place of the original single hatch; the **T-34/76D** with a hexagonal turret and wider mantlet, plus provision for jettisonable exterior fuel tanks; the **T-34/76E** with a cupola on the turret and of all-welded construction; and the **T-34/76F** identical to the T-34/76E apart from its cast rather than welded turret. (It should be noted that the designations are Western, designed to provide a means of identification in the absence of Soviet information.) In time the 76.2-mm (3-in) gun was replaced by an 85-mm (3.34-in) gun using the turret taken from the KV-85 heavy tank. This variant became the **T-34/85**, which remains in service to this day in some parts of the world. Special assault gun versions using the 85-mm (3.34-in) gun and later the 100-mm (3.94-in) or 122-mm (4.8-in) artillery pieces were developed, and flame-throwing, tractor, engineer and mine-clearing versions were also produced.

But it was as a battle tank that the T-34 has its main claim to fame. Available in thousands, the T-34 assumed mastery of the battlefield, forcing the Germans back on the defensive and taking from them the tactical and strategic initiative thus winning the 'Great Patriotic War' for the Soviet Union. Post-war the T-34 and its successors went on to gain more laurels, but it was as a war-winner in World War II that the T-34 must best be remembered. It was a superb tank.

Specification

T-34/76A
Crew: 4
Weight: 26 tonnes
Powerplant: one V-2-34 V-12 diesel developing 373 kW (500 hp)
Dimensions: length 5.92 m (19 ft 5.1 in); width 3 m (9 ft 10 in); height 2.44 m (8 ft)
Performance: maximum road speed 55 km/h (34 mph); maximum road range 186 km (115 miles); fording 1.37 m (4 ft 6 in); gradient 35°; vertical obstacle 0.71 m (2 ft 4 in); trench 2.95 m (9 ft 8 in)

Above: The commander of an early production T-34/76 tank looks out from his large one-piece hatch during Red Army exercises held during 1940, before the German invasion. At that time the T-34/76 was kept under security wraps and its appearance during the 1941 campaigns came as a nasty shock for the German Panzer troops.

Below: T-34s in East Prussia during the winter of 1944-5. By that time the main production version of the T-34 mounted an 85-mm (3.34-in) gun and was known as the T-34/85. This was an excellent tank that is still good enough to remain in service with many armies to this day – not bad for a vehicle introduced in 1944.

USSR

T-35 heavy tank

The **T-35** was one of the major disappointments for the Soviet tank designers before World War II. It had its origins in design studies that began in 1930, and the first prototype was rolled out in 1932. In appearance and in many other ways the T-35, via the T-28, was greatly influenced by the design of the British Vickers Independent, a tank that was produced as a one-off only and which featured in a notorious 'spy' court case of the period. The T-28 carried over from the Vickers design one major feature, namely the multi-turret concept.

Although there were changes between the various production batches, the tanks of the main batch (produced between 1935 and 1938) were longer than the originals. This increase in length made the T-35 an unwieldly beast to steer, and its ponderous weight did little to improve matters. The multi-turret approach to tank weaponry also proved to be of doubtful value. Aiming and co-ordinating the fire of the five turrets proved very difficult, and the overall effectiveness of the armament was further limited by the relatively small calibre of the main gun. In fact the main gun and turret were exactly the same as those used on the lighter T-28 medium tank. Armour varied from 10 to 30 mm (0.39 to 1.18 in) in thickness.

Production of the T-35 was slow and limited compared with that of other Soviet tank programmes of the time. Only 61 were produced between 1933 and 1939, and all of these vehicles served with just one tank brigade stationed near Moscow. This was politically handy, for the T-35s featured regularly in the Red Square parades of the time and thus provided a false impression of Soviet tank strengths. The massive vehicles made a great impression as they rumbled past, but the service reality was considerably different.

When they had to go to war in 1941 only a relative handful actually saw action, for many were retained in Moscow for internal duties and for purely local defence. There appears to be no record of any T-35s going into action around Moscow, but the few used elsewhere to try to halt the German advances did not fare well. They were too lightly armed and their weight and bulk made them easy meat for the Panzers.

Specification

T-35

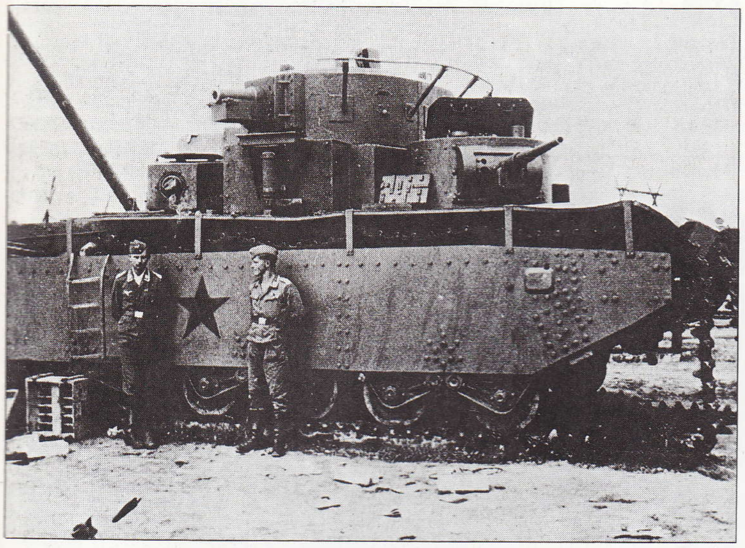
Crew: 11

Weight: 45 tonnes

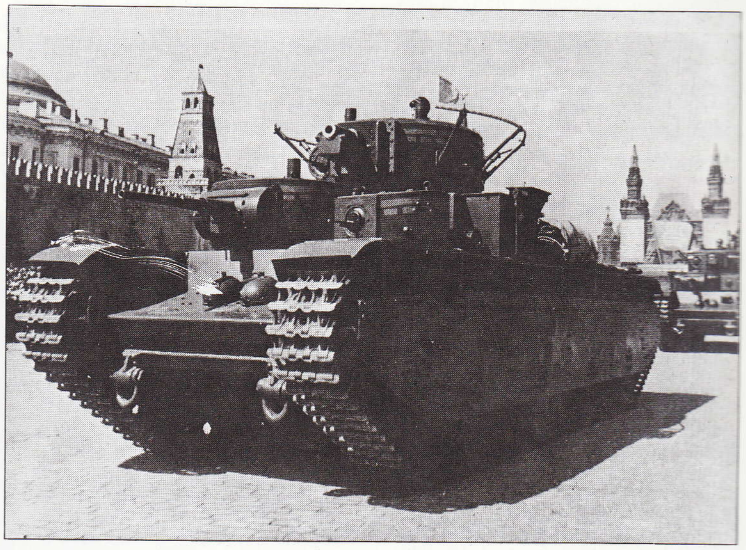
Powerplant: one M-17M V-12 petrol engine developing 373 kW (500 hp)

Dimensions: length 9.72 m (31 ft 10.7 in); width 3.2 m (10 ft 6 in); height 3.43 m (11 ft 3 in)

Performance: maximum road speed 30 km/h (18.6 mph); maximum road range 150 km (93.2 miles); fording not known; gradient 20°; vertical obstacle 1.20 m (4 ft); trench 3.50 m (11 ft 6 in)



The huge size of the T-35 can be readily appreciated in this shot of a damaged and captured example being put on show by German soldiers. The main turret had a 76.2-mm (3-in) gun with limited anti-armour performance, and two of the smaller turrets had 37-mm or 45-mm (1.45-in or 1.77-in) guns.



The T-35 heavy tank made an impressive showing on parade in Red Square, but in action they made little impact, with only about 60 built. Fire control of the five turrets was very difficult and the great length of the hull made it a cumbersome vehicle.

USSR

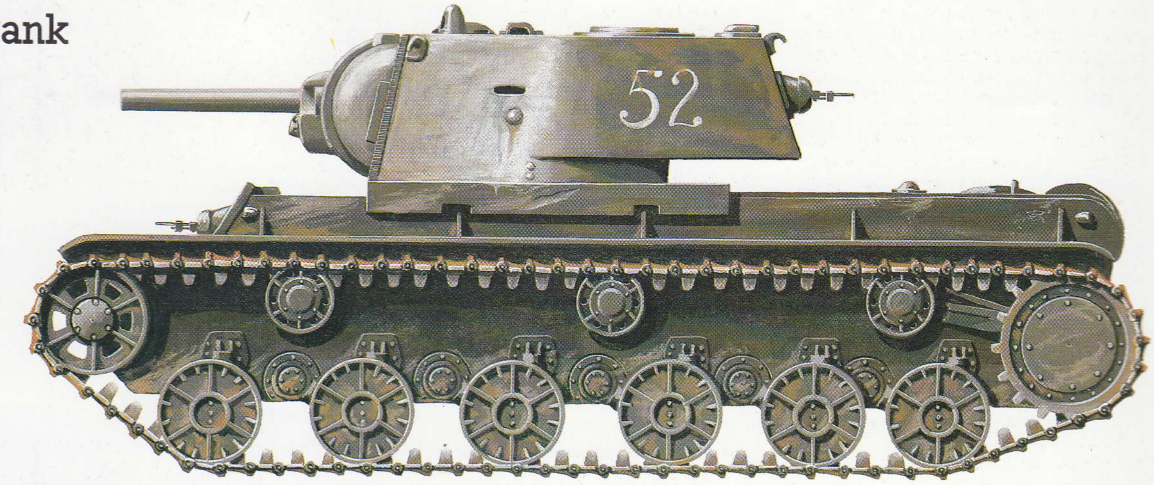
KV-1 heavy tank

By 1938 Soviet tank designers had realized that the T-35 heavy tank would need replacement and set about the design of its successor. Several design bureaux were involved and many proposed designs with multiple turrets, but by the time prototypes were produced most had just two turrets. This approach still did not appeal to one of the teams, which designed a heavy tank with only one turret and named it after Klimenti Voroshilov, who was defence commissar at the time. Known as the **KV-1**, the new design was far more mobile than the other submissions and was field-tested during the campaign in Finland in 1940. This first variant was armed with a short 76.2-mm (3-in) gun and three or four 7.62-mm (0.3-in) machine-guns, and armour up to 100-mm (3.94-in) thick was provided.

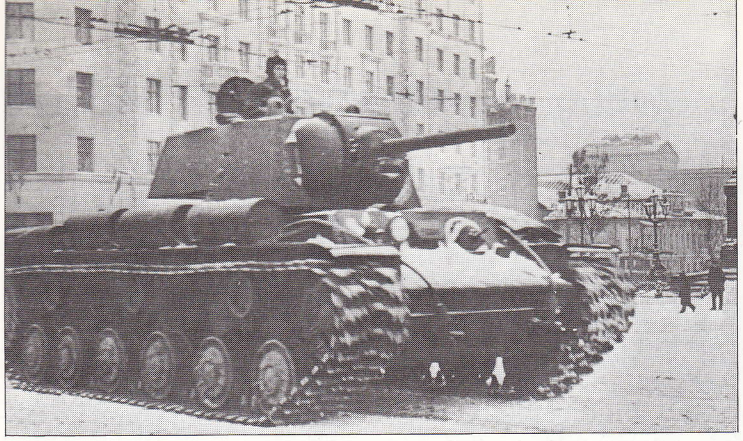
The KV-1 was ordered into production in two main forms: one was the **KV-1A** armed with a long 76.2-mm (3-in) gun, while the other version was the **KV-2**, a marriage of the KV-1 hull, chassis and suspension with a large slab-sided turret mounting a 152-mm (5.98-in) howitzer (originally a 122-mm/4.80-in howitzer). Thus the KV-2 did not lack in firepower, but the high turret was a ponderous load for the vehicle and the KV-2 (and improved **KV-2B**) did not shine in action.

With the KV-1 the future for Soviet tank design was established for some time to come. The old multi-turret concept was finally set aside, and the KV-1 emerged as a formidable heavy tank that was to serve the Red Army for years. It was used often as an assault or break-through tank, forming the spearhead of many attacks, and as the war against Germany progressed the basic design was gradually improved. High on the list of improvements were armour increases, achieved with the **KV-1B** that had an extra 25-35 mm (0.98-1.38 in) added to the hull front and sides. Other changes were made in the turret which progressed from being a mainly plated affair to a fully cast component, which on the **KV-1C** also gave an increase in protection. Much of the extra armour was simply bolted onto existing armour.

For its size the KV-1 was undergunned, but a scheme to increase the armament to a 107-mm (4.2-in) weapon never came to anything other than trials. Instead the 76.2-mm (3-in) gun



The KV-1 heavy tank originally mounted a 76.2-mm (3-in) main gun on a chassis that was to be adapted for later models of Soviet heavy tanks. Several versions existed as progressive production changes were introduced to speed manufacture and improve protection for the crew of five.



A KV-1 rolls through snowy Moscow streets to the front in December 1941. The heavy tank had a 76-mm main gun (later to be replaced by an 85-mm weapon) and was used by the Red Army as a breakthrough tank where its lack of speed was not a handicap.

On the vast open spaces of the Russian plain, the lack of mobility inherent in the KV-1 was a definite handicap. In the campaigns of 1942 many KV-1s were lost due to mechanical failure. The tank was improved, however, and was to lead to the powerful Josef Stalin tanks.

was lengthened and the 152-mm (5.98-in) gun in its clumsy turret was withdrawn. After 1943 numbers of 85-mm (3.34-in) guns were fitted, and this model was known as the **KV-85**.

The KV-1 was a sound design, but had some serious automotive problems. On early models it was almost impossible to change gear because of clutch problems, and there were other transmission difficulties. Many of them were eventually eliminated but the numerous increases in armour protection were usually carried out with no increases in engine power, though the KV-1C had an extra 75 kW (100 hp), so many examples were quite unable to reach their expected performance. One solution attempted in a small number of **KV-1S** (*skorostnoy*, or fast) tanks was the omission of applique armour to reduce weight and so raise speed. One serious problem tactically was that the turret was so arranged internally that the tank commander had to double as gun loader, a situation that often put him out of touch with the tactical situation for critical periods. Later versions had the usual angled armour of most other Soviet tank designs, and overall the KV-1 was a bit of a problem for German anti-tank units.

Specification

KV-85

Crew: 5

Weight: 43 tonnes

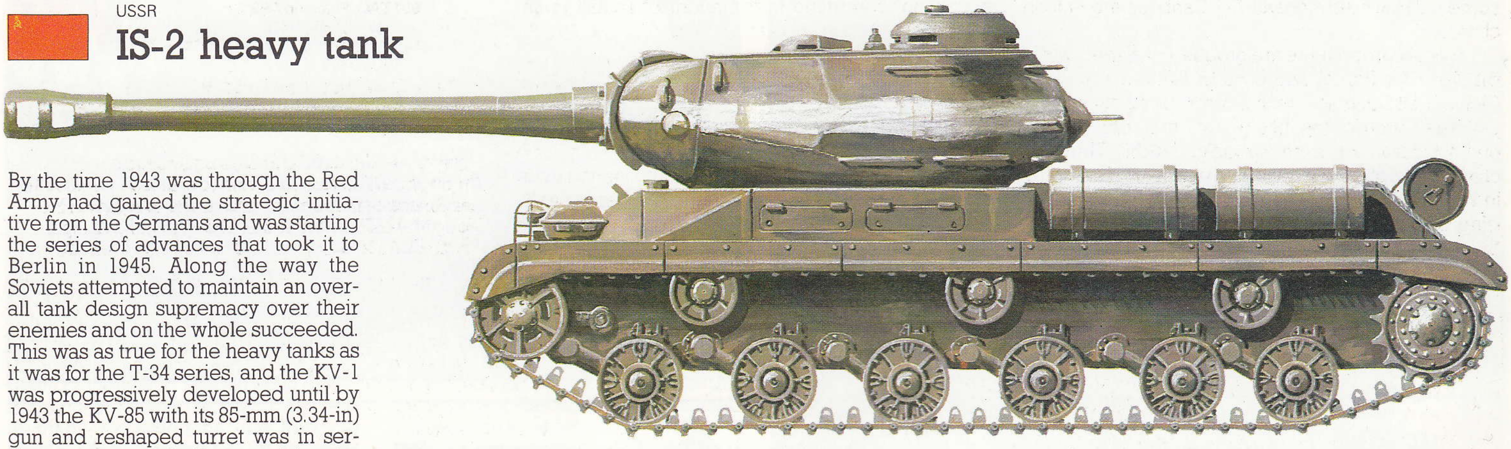
Powerplant: one V-2K V-12 diesel developing 448 kW (600 hp)

Dimensions: length 6.68 m (21 ft 11 in); width 3.32 m (10 ft 10.7 in); height 2.71 m (8 ft 10.7 in)

Performance: maximum (rarely achieved) road speed 35 km/h (21.75 mph); maximum road range 150 km (93.2 miles); fording not known; vertical obstacle 1.20 m (3 ft 8 in); gradient 36°; vertical obstacle 1.20 m (3 ft 11.25 in); trench 2.59 m (8 ft 6 in)

USSR

IS-2 heavy tank



The IS-2 was introduced into service with the Red Army during 1944 and was the most powerful of all the Soviet heavy tanks. It mounted a long 122-mm (4.8-in) gun in a well-protected cast turret, and carried a crew of four. Ammunition stowage was limited to 28 rounds.

By the time 1943 was through the Red Army had gained the strategic initiative from the Germans and was starting the series of advances that took it to Berlin in 1945. Along the way the Soviets attempted to maintain an overall tank design supremacy over their enemies and on the whole succeeded. This was as true for the heavy tanks as it was for the T-34 series, and the KV-1 was progressively developed until by 1943 the KV-85 with its 85-mm (3.34-in) gun and reshaped turret was in service. But by gradually reworking the transmission, reshaping and redesigning the hull and suspension, a new lower and lighter tank design was evolved. The new design was named the **IS-1** (IS for Iosef Stalin).

The IS-1 retained the 85-mm (3.34-in) gun of the KV-85, and was in its earliest forms known as the **IS-85**, but it was felt that the new design could accommodate a more powerful weapon. Trials were carried out with a new 100-mm (3.94-in) gun (**IS-100** variant) and a long 122-mm (4.8-in) gun, the 100-mm (3.94-in) gun proving to be the better armour-penetration weapon. However, the 122-mm (4.8-in) gun was almost as effective and also had the explosive power to blow off an enemy tank turret even if it could not penetrate its armour. To cap things in the 122-mm (4.8-in) gun's favour, potential numbers were available while the 100-mm (3.94-in) gun was still not in full production.

So the IS tank was fitted with the long 122-mm (4.8-in) gun and this became the **IS-2**, which had a number of other improvements. The first examples appeared in 1944 and remained in production and service until the war ended. It was a massive vehicle, its size emphasized by the long gun barrel. The turret and hull were more than amply supplied with armour (maximum of 132 mm/5.2 in), but the Red Army tank crews placed greater importance on the tank-killing power of the 122-mm (4.8-in) gun. This gun had a slow rate of fire and used separate ammunition, which further slowed the loading time (the A-19 was originally designed as a naval gun), and the ammunition was so large that only 28 rounds could be carried inside the tank. The secondary armament comprised one 12.7-mm (0.5-in) and one 7.62-mm (0.3-in) machine-gun. Later versions introduced a modified fire-control system and a revised breech to increase the speed of loading. Other changes were introduced at the same time, but more were to come.

Good as the IS-2 was, it was felt that it could still be improved. The result was the **IS-3** which retained the 122-mm (4.8-in) gun but in a drastically revised well-rounded turret behind a new and heavily sloped bow shape combined with the usual armour. Only a few IS-3s were completed before the war ended, but the type went on to worry Western military thinkers for many years afterwards as it remained the most powerful tank in the world for well over a decade (it is still employed in some Soviet-influenced nations).

Specification

IS-2

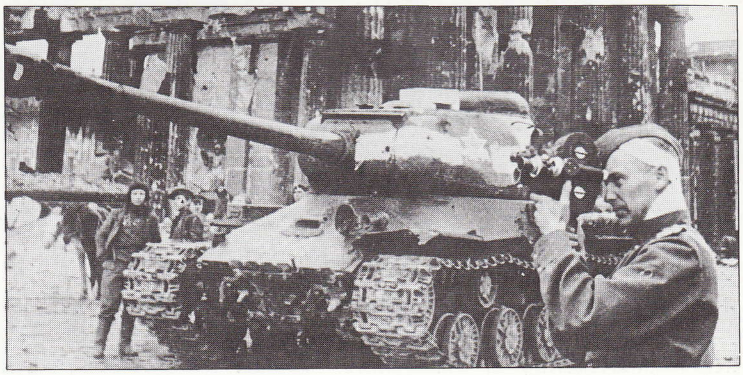
Crew: 4

Weight: 46 tonnes

Powerplant: one V-2-IS (V-2K) V-12 diesel developing 447 kW (600 hp)

Dimensions: length 9.9 m (32 ft 5.8 in); width 3.09 m (10 ft 1.6 in); height 2.73 m (8 ft 11.5 in)

Performance: maximum road speed 37 km/h (23 mph); maximum road range 240 km (149 miles); fording not known; gradient 36°; vertical obstacle 1.0 m (3 ft 3 in); trench 2.49 m (8 ft 2 in)



When the Red Army finally reached Berlin in May 1945 IS-2 tanks were at the head of the armoured forces; this example is seen near the Reichstag. Note the great length of the 122-mm (4.8-in) gun and the well-shaped turret and front glacis plate that could deflect armour-piercing projectiles.

Armed Forces of the World

US Air Force

Part 8

The two second-line elements of the US Air Force are very much in the aircraft-operating business, possessing close to 2,000 between them. With about 420 aircraft, the Air Force Reserve (AFRes) at Robins AFB, Georgia, is the smaller of the two commands and is mainly engaged in the transport role although combat types have been added in recent years. Organization follows the usual lines, AFRes controlling three numbered air forces, namely the 4th Air Force at McClellan, the 10th Air Force at Bergstrom and the 14th Air Force at Dobbins, each being responsible for co-ordinating the activities of several subordinate wings and groups.

Airlift assets are distributed between the 4th and 14th Air Forces, and include the so-called 'Associate' wings by which AFRes personnel man USAF C-141B StarLifters and C-5A Galaxies, so operating alongside regular MAC squadrons. It is worth noting in this context that the AFRes now provides almost 50 per cent of flight crews for these two types. The AFRes also has a number of airlift units with their own aircraft, the Lockheed C-130 Hercules being the predominant type assigned to these although some de Havilland Canada C-7 Caribous are still on charge.

Tactical components are grouped together within the 10th Air Force, and include five squadrons of McDonnell Douglas F-4 Phantoms, three squadrons with the Fairchild Republic A-10A Thunderbolt II and one squadron with the Republic F-105D Thunderchief, although the last will give way to the F-16 early in 1984 as part of the continuing process of modernizing second-line forces. The 10th Air Force also controls three Boeing KC-135A tanker squadrons, two 'Associate' squadrons providing crews for SAC McDonnell Douglas KC-10A Extenders and a single Special Operations Squadron with the Lockheed AC-130A Hercules gunship.

The remaining 1,600 or so aircraft which are assigned to second-line elements are all operated by the Air National Guard (ANG) which maintains its headquarters at Andrews AFB and which has also been the subject of some modernization in the past few years, examples of new production aircraft such as the A-10, A-37 and C-130 having been turned over straight from the factory, whilst one squadron recently converted to the F-16A, receiving aircraft which had seen service with the regular US Air Force but which had been brought to virtually the latest modification standard before delivery to the ANG.

Organized on a state basis, with at least one flying unit in each of the 50 states plus others allocated to Puerto Rico and the District of Columbia, the ANG currently has 91 squadrons engaged in a variety of missions and with a commensurate variety of equipment. Like the AFRes, the ANG unit would report to a 'gaining' command in the event of mobilization, tactical and air defence units joining TAC, airlift units going to MAC and tanker squadrons reporting to SAC. Under the recently introduced 'total force' concept, ANG units are expected to achieve and maintain a state of combat readiness in order that they can respond immediately to mobilization orders. That the ANG takes its duty seriously is reflected by performance in recent years, ANG elements achieving consistently good results in competitions such as 'William Tell', in 'Red Flag' exercises and in overseas deployments, the last being a regular aspect of the year's work. Types at present operated by the Air National Guard include the Lockheed C-130, Boeing KC-135, Vought A-7, Fairchild Republic A-10, Cessna OA-37, McDonnell Douglas F-4/RF-4, General Dynamics F-16 and Convair (GD) F-106.

AIR FORCE RESERVE

HEADQUARTERS ROBINS AFB, Ga
  4TH AIR FORCE, McCLELLAN AFB, Ca
  10TH AIR FORCE, BERGSTROM AFB, Tx
  14TH AIR FORCE, DOBBINS AFB, Ga
4TH AF, McCLELLAN AFB, Ca
  349 MAW (Assoc), Travis AFB, Ca
    301/312 MAS (C-5A)
    708/710 MAS (C-141B)
  445 MAW (Assoc), Norton AFB, Ca
    728/729/730 MAS (C-141B)
  446 MAW (Assoc), McChord AFB, Wa
    97/313 MAS (C-141B)
  433 TAW, Kelly AFB, Tx
    68 TAS (C-130B)
    901 TAG, Peterson AFB, Co
      731 TAS (C-130B)
    934 TAG, Minneapolis-St Paul MAP, Mn
      96 TAS (C-130A)
  440 TAW, Mitchell Field, Wi
    95 TAS (C-130A)

Every year the ANG deploys squadrons throughout Europe in order to enhance the battle readiness of these part-time units. Here a pair of Vought A-7Ds of the 175th TFS (Sioux Falls Apt, South Dakota) taxi out for a mission in Germany.

USAF
U.S. AIR FORCE
60222

The Lockheed C-5A Galaxy is the largest aircraft in the USAF inventory, and substantial numbers are operated by Air Force Reserve personnel from 'Associate Wings' which operate alongside regular MAC squadrons. The AFRes now provides almost half of the Galaxy's flight crews.

  - 927 TAG, Selfridge ANGB, Mi
    - 63 TAS (C-130A)
  - 928 TAG, O'Hare IAP, Il
    - 64 TAS (C-130A)
- 403 RWRW, Selfridge ANGB, Mi
  - 305 ARRS (HC-30H/N, HH-3E)
  - 301 ARRS, Homestead AFB, Fl (HC-130H/N, HH-3E)
  - 303 ARRS, March AFB, Ca (HC-130H)
  - 304 ARRS, Portland IAP, Or (HH-1H, UH-1N)
  - 920 WRG, Keesler AFB, Ms
    - 815 WRS (WC-130H)
- 302 SOS, Luke AFB, Az (CH-3E)
- 919 SOG, Duke Field, Fl
  - 711 SOS (AC-130A)

10th AF, Bergstrom AFB, Tx

- 301 TFW, Carswell AFB, Tx
  - 457 TFS (F-4D)
  - 924 TFG, Bergstrom AFB, Tx
    - 704 TFS (F-4D)
- 419 TFW, Hill AFB, Ut
  - 466 TFS (F-16A)
  - 507 TFG, Tinker AFB, Ok
    - 465 TFS (F-4D)
- 434 TFW, Grissom AFB, In
  - 45 TFS (A-10A)
  - 442 TFG, Richards-Gebaur AFB, Mo
    - 303 TFS (A-10A)
  - 917 TFG, Barksdale AFB, La
    - 46 TFTS (A-10A)
    - 47 TFS (A-10A)
  - 926 TFG, New Orleans NAS, La
    - 706 TFS (A-10A)
- 482 TFW, Homestead AFB, Fl
  - 93 TFS (F-4D)
  - 906 TFG, Wright-Patterson AFB, Oh
    - 89 TFS (F-4D)
- 452 ARW, March AFB, Ca
  - 79 ARS (Assoc) (KC-10A)
  - 336 ARS (KC-135A)
  - 931 ARG, Grissom AFB, In
    - 72 ARS (KC-135A)
  - 940 ARG, Mather AFB, Ca
    - 314 ARS (KC-135A)
  - 78 ARS (Assoc), Barksdale AFB, La (KC-10A)

14TH AF, DOBBINS AFB, Ga

- 315 MAW (Assoc), Charleston AFB, SC
  - 300/701/707 MAS (C-141B)
- 512 MAW (Assoc), Dover AFB, De
  - 326/709 MAS (C-5A)
- 514 MAW (Assoc), McGuire AFB, NJ
  - 335/702/732 MAS (C-141B)
- 94 TAW, Dobbins AFB, Ga
  - 700 TAS (C-130H)
  - 907 TAG, Rickenbaker ANGB, Oh
    - 356 TAS (C-130A, UC-123K)
  - 908 TAG, Maxwell AFB, Al
    - 357 TAS (C-130E)
- 439 TAW, Westover AFB, Ma
  - 337 TAS (C-130E)
  - 911 TAG, Greater Pittsburgh IAP, Pa
    - 758 TAS (C-130A)
  - 914 TAG, Niagara Falls IAP, NY
    - 328 TAS (C-130A)
- 459 TAW, Andrews AFB, Md
  - 756 TAS (C-130E)
  - 910 TAG, Youngstown MAP, Oh
    - 757 TAS (C-130B)
  - 913 TAG, Willow Grove NAS, Pa
    - 327 TAS (C-130E)
- 932 AAG (Assoc), Scott AFB, Il
  - 73 AAS (C-9A)

Note: In addition to the units detailed here, there are numerous supporting elements active within the overall AFRES framework, these including the Air Reserve Personnel Centre at Denver, Colorado; in excess of 50 Aerial Port Squadrons; approximately 36 Weapons System Security Flights; 30-plus Consolidated Aircraft Maintenance Squadrons; and varying quantities of Aeromedical Evacuation Squadrons, Medical Service Squadrons, Combat Support Groups/Squadrons, Civil Engineering Squadrons and other organizations.

AIR NATIONAL GUARD FLYING UNITS

101 FIS/102 FIW, Otis ANGB, Ma (F-106A/B)
102 ARRS/106 ARRG, Suffolk County Apt, NY (HC-130H/P, HH-3E)
103 TASS/111 TASG, Willow Grove NAS, Pa (OA-37B)
104 TFS/175 TFG, Baltimore Apt, Md (A-10A)
105 TAS/118 TAW, Nashville Apt, Tn (C-130A)
106 TRS/117 TRW, Birmingham Apt, Al (RF-4C)
107 TFS/127 TFW, Selfridge ANGB, Mi (A-7D)
108 ARS/126 ARW, O'Hare IAP, Il (KC-135E)
109 TAS/133 TAW, Minneapolis-St Paul Apt, Mn (C-130E)
110 TFS/131 TFW, St Louis IAP, Mo (F-4C)
111 FIS/147 FIG, Ellington AFB, Tx (F-4C)
112 TFS/180 TFG, Toledo Apt, Oh (A-7D)
113 TFS/181 TFG, Terre Haute Apt, In (F-4C)
115 TAS/146 TAW, Van Nuys Apt, Ca (C-130E)
116 ARS/141 ARW, Fairchild AFB, Wa (KC-135A)
117 ARS/190 ARG, Forbes Field ANGB, Ks (KC-135A)
118 TFS/103 TFG, Bradley Field, Ct (A-10A)
119 FIS/177 FIG, Atlantic City Apt, NJ (F-106A/B)
120 TFS/140 TFW, Buckley ANGB, Co (A-7D)
121 TFS/113 TFW, Andrews AFB, Md (DC ANG) (F-4D)
122 TFS/159 TFG, New Orleans NAS, La (F-4C)
123 FIS/142 FIG, Portland IAP, Or (F-4C)
124 TFS/132 TFW, Des Moines Apt, Ia (A-7D)
125 TFS/138 TFG, Tulsa IAP, Ok (A-7D)
126 ARS/128 ARG, Mitchell Field, Ws (KC-135E)
127 TFTS/184 TFTG, McConnell AFB, Ks (F-4D)
128 TFS/116 TFW, Dobbins AFB, Ga (F-4D)
129 ARRS/129 ARRG, Moffett Field NAS, Ca (HC-130H/P, HH-3E)
130 TAS/130 TAG, Charleston Apt, WV (C-130E)
131 TFS/104 TFG, Westfield Apt, Ma (A-10A)
132 ARS/101 ARW, Bangor IAP, Me (KC-135A)
133 ARS/157 ARG, Pease AFB, NH (KC-135A)
134 TFS/158 TFG, Burlington IAP, Vt (F-4D)
135 TAS/135 TAG, Baltimore Apt, Md (C-130B)
136 FIS/107 FIG, Niagara Falls IAP, NY (F-4C)
137 TASS/105 TASG, White Plains Apt, NY (O-2A)
138 TFS/174 TFW, Syracuse Apt, NY (A-10A)
139 TAS/109 TAG, Schenectady Apt, NY (C-130D)
141 TFS/108 TFW, McGuire AFB, NJ (F-4D)
142 TAS/166 TAG, Greater Wilmington Apt, De (C-130A)
143 TAS/143 TAG, Quonset State Apt, RI (C-130A)
144 TAS/176 TAG, Kulis ANGB, Ak (C-130H)
145 ARS/160 ARG, Rickenbacker AFB, Oh (KC-135A)
146 TFS/112 TFG, Greater Pittsburgh IAP, Pa (A-7D)
147 ARS/171 ARW, Greater Pittsburgh IAP, Pa (KC-135E)
149 TFS/192 TFG, Richmond Apt, Va (A-7D)
150 ARS/170 ARG, McGuire AFB, NJ (KC-135E)
151 ARS/134 ARG, Knoxville Apt, Tn (KC-135E)
152 TFTS/162 TFTG, Tucson IAP, Az (A-7D/K)
153 TRS/186 TRG, Meridian Apt, Ms (RF-4C)
154 ARS/189 ARG, Little Rock AFB, Ar (KC-135A)
155 TAS/164 TAG, Memphis IAP, Tn (C-130A)
156 TAS/145 TAG, Charlotte Apt, NC (C-130B)
157 TFS/169 TFG, McEntire ANGB, SC (F-16A)
158 TAS/165 TAG, Savannah Apt, Ga (C-130H)
159 FIS/125 FIG, Jacksonville IAP, Fl (F-106A/B)
160 TFS/187 TFG, Montgomery Apt, Al (F-4D)
162 TFS/178 TFG, Springfield Apt, Oh (A-7D)
163 TFS/122 TFW, Fort Wayne Apt, In (F-4C)
164 TAS/179 TAG, Mansfield (Lahm) Apt, Oh (C-130B)
165 TRS/123 TRW, Louisville Apt, Ky (RF-4C)
166 TFS/121 TFW, Rickenbacker AFB, Oh (A-7D)
167 TAS/167 TAG, Martinsburgh Apt, WV (C-130B)
169 TASS/182 TASG, Peoria Apt, Il (OA-37B)
170 TFS/183 TFG, Springfield Apt, Il (F-4D)
171 FIS/191 FIG, Selfridge ANGB, Mi (F-4C)
172 TASS/110 TASG, Battle Creek ANGB, Mi (OA-37B)
173 TRS/155 TRG, Lincoln Apt, Ne (RF-4C)
174 TFS/185 TFG, Sioux City Apt, Ia (A-7D)
175 TFS/114 TFG, Sioux Falls Apt, SD (A-7D)
176 TFS/128 TFW, Truax Field, Wi (A-10A)
178 FIS/119 FIG, Faro Apt, ND (F-4D)
179 FIS/148 FIG, Duluth IAP, Mn (F-4D)
180 TAS/139 TAG, St Joseph Apt, Mo (C-130A)
181 TAS/136 TAW, Dallas NAS, Tx (C-130B)
182 TFS/149 TFG, Kelly AFB, Tx (F-4C)
183 TAS/172 TAG, Jackson Apt, Ms (C-130H)
184 TFS/188 TFG, Fort Smith Apt, Ar (F-4C)
185 TAS/137 TAW, Oklahoma City Apt, Ok (C-130H)
186 FIS/120 FIG, Great Falls IAP, Mt (F-106A/B)
187 TAS/153 TAG, Cheyenne Apt, Wy (C-130B)
188 TFS/150 TFG, Kirtland AFB, NM (A-7D)
190 TRS/124 TRG, Boise Apt, Id (RF-4C)
191 ARS/151 ARG, Salt Lake City IAP, Ut (KC-135E)
192 TRS/152 TRG, Reno IAP, Nv (RF-4C)
193 SOS/193 SOG, Harrisburg IAP, Pa (EC-130E)
194 FIS/144 FIG, Fresno Apt, Ca (F-4D)
196 TFS/163 TFG, March AFB, Ca (F-4C)
197 ARS/161 ARG, Phoenix IAP, Az (KC-135E)
198 TFS/156 TFG, Muniz ANGB, Puerto Rico (A-7D)
199 TFS/154 CG, Hickam AFB, HI (F-4C, C-7A)